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THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LIX.—No. 25. Whole No. 967. | NEW YORK, MONDAY, DECEMBER 18, 1893. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, N. Y.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post-office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Collections are invariably made directly from this office, for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

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CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told 865

Lost, a Photometrical Equipment—Against the Smoke Nuisance—The Absorption of the Forest City Chemical Company—The Peoria Terminal Railway Company vs. the Peoria Gas Light and Coke Company.

*A New System of Lighting and Extinguishing Street Gas Lamps without the Use of Wires 866

The Stacking of Coal and Coal Haulage Machinery, by Mr. J. Chadwick 867

The Use of Small Sizes of Anthracite Coal for Generating Steam, by Mr. E. B. Coxe 869

The Widening Use of Compressed Air, by Mr. W. P. Pressinger 871

Notes on Water Power Equipment 873

Combination Heating, by Mr. George Hoffman 874

Progress of Smoke Abatement in St. Louis 874

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 875

To Start Up at Huntington, L. I.—Improvements at Vancouver, B. C.—Contract for the Berlin Iron Bridge Company—To Try Another Scheme at the Point Breeze Works, Phila., Pa.—Portland (Ore.) Arcs Go Out—Public Lighting, Cohoes, N. Y.—Cheaper Gas for Malden, Mass.—New Departments in the Business of the Augusta (Ga.) Company—Public Lighting, Lawrence, Mass.—Frank Richardson is a Colonel—San Francisco Gas Dividends—The Sunflowers Gave a Ball, but Did Not Pay for the Light—Gas Rates at Milton, Pa.—Generous Act by the Altoona (Pa.) Company—The Fall River (Mass.) Company in New Offices—Newton, Mass., Talks of Municipal Lighting—A Bit of History about the Artificial Lighting of Waltham, Mass.—A Wilkes-Barre, Pa., Ordinance—And Other Items.

Transportation of Liquid Air 877

The Market for Gas Securities 878

BRIEFLY TOLD.

LOST, A PHOTOMETRICAL EQUIPMENT.—The excitement over the last political contest in Erie county, New York, having been partially allayed by the defeat of the Sheehan cohorts, it was but natural that the turbulently inclined of Buffalo's residents should seek another cause for stimulation. Nor did they have to waste much time in settling upon an object that would enable them to engage in wordy warfare, a species of amusement that appeals most forcibly to the average Buffalonian. Not to be too long in telling the story, we might as well come to the point at once, which we can and do by remarking that the Gas Companies of the city were those that engaged the attention of the reformers. With the shortening of the hours of daylight, of course gas lights were in evidence longer than was the case when the sun was further in the south, and it soon was bruited about that the Buffalo Companies were not furnishing an illuminating medium of a candle value up to that required under the ordinance of the city; not only so, but that the article supplied was far below the stipulation. From the mouths of the Buffalonians the argument was finally transferred to the newspaper columns, and then the battle waxed warm. All of them in unison could not make much objection to the rates charged, as everyone was agreed that gas at $1 per 1,000 was pretty cheap; in fact, it had to be admitted that it was the cheapest gas rate in the State. Still, they argued, what benefit is cheap gas to us if it be not good gas? a position that would undoubtedly be a correct one were it based on solid grounds. Under the ordinance or agreement by which the Buffalo Companies supply gas to the public lamps and the public buildings, the contractors are obliged to supply an illuminating agent having an illuminating value of not less than 18 candles, and as the city is supposed to have frequent tests of the gas made, and was presumed to be the possessor of a departmental room fully equipped with the necessary photometrical apparatus, which apparatus was to be manipulated by the City Chemist, a person outside of Buffalo might be forgiven for holding that it would be a comparatively simple matter to determine whether or not the Companies were keeping to their agreement. To be sure the Companies were in the habit of testing the candle power of the product at their works with systematic, virtually continuous frequency for their own guidance and control, and it is equally certain that the authorities could see this thing done for themselves, or have verified reports of the testings given them for the mere asking; but that would not do. Such reports would be biased and untrustworthy; although such a verdict would seem very much like convicting the Companies of a desire to fool themselves. At any rate, it was generally understood that the Companies' tests showed that the gas manufactured by them was averaging close to 19 candles, whereas the turbulent Buffalonians, and their equally boisterous allies, the newspapers, looking at the flame with their well-balanced photometric vision, were positive that the candle value was nearer to 16 candles than to 19—in fact, some of them feared 15 was closer to the mark. In due time they remembered the City Chemist and his testing machine, whereupon he was invoked to hold the necessary trials. That official, however, had to plead *non quo, sed quomodo.* In other words, he admitted that he might not say the demand made upon him was not his to answer, but the main difficulty was as to how he should set about it. Be he ever so willing to mind and carry out the task, the apparatus at his command was weak; in fact, some of its parts were lost when the photometer quarters were removed from the first location in a room in the Lewis Block to "special apartments" in the Municipal Court Building. The City Chemist, who is a very competent gentleman named Hill, acknowledged that he had made no tests of the gas since he assumed his office—he succeeded Mr. Vandenburgh, who found no difficulty in keeping official record at appropriate intervals of the candle power of Buffalo's gas during his term of office, to which we might also add that he never found it below the legal requirements—nor could he well do other-

wise, considering the "missing links" in the apparatus. In the meantime the cry now goes forth for either a new apparatus or at least a repaired one, which plaint we hope will be speedily stilled by the procuring of all that is needed to enable the Chemist to "do his full duty." The Buffalonians, however, can take our word for it—and we are dimly conscious that they will not—that the engineers of the Buffalo Gas Companies are not engaged in any attempt to fool themselves over the candle value of the gas they are manufacturing, and that "all Buffalo" will so discover when that lame public photometer of theirs is put in good working order.

AGAINST THE SMOKE NUISANCE, ROCHESTER, N. Y.—Some time ago we noted the institution of proceedings, by certain residents of Rochester, N. Y., against the proprietors of the Rochester Gas and Electric Company, in which complainants sought to restrain defendants from injuring their property by the action of the smoke which was emitted from the chimneys of the Company's steam plant. The case was argued before Justice Rumsey, and judgment was given for plaintiffs, who are ordered to abate the nuisance on and after January 8th. We regret that our correspondent failed to forward us the text of Justice Rumsey's decision, since we must for the present be content to give the bare finding without comment. The general trend of proceedings like this undoubtedly favors the suppression of what is termed the "smoke nuisance," for we have right here in New York a notable instance in the passage of a resolution by the Health Board declaring that the smoke emitted from the chimneys of the New York Steam Heating Company is a menace to public health, and an accompanying order that the matter complained of must be remedied. On general principles smoke is objectionable, nor would it be difficult to furnish a formidable list of specific objections to its presence, still it must be remembered that the steam raiser would vastly rather his business could be carried on without a vestige of the objectionable presence, which is as unsightly and depressing *per se* to himself as it is to others, whether they be his neighbors or casual passers-by. In that light we can mainly account for the smoke pall in the knowledge that the cost of the fuel used is what impels the Steam Company, for instance, to burn bituminous coal under its boilers in preference to anthracite. We make no doubt that those who take steam from the Steam Company would pronouncedly object to an increase in the rate at which they are served, still the cheaper the Company can deliver to its customers its product, the better is the chance of the customer for a reduction in the rate; nor can there be any doubt that the use of bituminous coal instead of anthracite would mean a very large saving to the Company. What we wish to say is that the "smoke suppression" movement should not be decided in too summary a manner, for smoke raisers have rights that even "smoke suppressors" are bound to respect.

THE ABSORPTION OF THE FOREST CITY CHEMICAL COMPANY.—Of course, this is not a new story by any means, for public notice was given as far back as July last of the absorption by the S. E. Barrett Manufacturing Company of the Forest City Chemical Company, but the merger is none the less regrettable on account of the time over which it has been successfully tried. The Barrett Company has always contended that it was a blessing to the producers of gas tar; and it may be so, yet many gas men will vote with us in saying that its blessings have been very well disguised. Since it has gained a good, substantial foothold—many necks, by the way, have felt the Barrett Company's sole—tar prices, so far as the producers of the material are concerned, have been declining, pretty much, too, in equal pace with the buying out or crushing out of individual tar refining plants. In time, we presume, the tar producers will come together a little closer, with the result that their combination as sellers may equal in strength the combination of the refiners as purchasers.

THE PEORIA TERMINAL RAILWAY COMPANY VS. THE PEORIA GAS LIGHT AND COKE COMPANY.—On a retrial of this case, under which the plaintiff sought to have the court fix a price for property taken for its use from the Gas Company, the latter was awarded the sum of $8,400, which, although somewhat in excess of the amount awarded on the original trial, is certainly not one-fourth of the award that should have been made. When the case was first tried it was fully reported in our columns, and as the testimony just taken was similar in most respects to that of the first hearing, there is no particular reason for repeating it. We might say, however, that the Terminal Company owes much to a certain expert witness—he is very prominent in the gas engineering circles of Chicago—who could not have exerted himself more in its interest than if he had been retained as a railroad engineering expert. The Gas Company will likely appeal the case again.

A New System of Lighting and Extinguishing Street Gas Lamps Without the Use of Wires.

An electrical system which operates at will, from a central point, devices placed miles apart with no electrical connection between them, sounds like a fairy tale, still this is in fact not only possible, but commercially practical. The Cutler system discards the unsightly overhead wires and the expensive underground circuit, and adopts an entirely new and inexpensive method. Each lamp is supplied with two sal ammoniac batteries and a spark coil, placed in an iron box buried in the ground at the foot of the post. In the lantern is a miniature gasholder of about 2 cubic inches capacity, pivoted on a hinge and held down by weights; and directly over this holder is an automatic gas lighter, similar to those used in houses, only much simpler, larger and stronger. Two wires, about 10 feet long, connect the lighter with the batteries through the post. Such an installation is under complete control from the gas works.

When it is desired to light the lamps of a city, it is only necessary to open the valve connecting one of the large gasholders at the works direct with the gas mains. This results in a decided increase of pressure in the gas all over the city, sufficient to cause all the little gasholders in the lamp posts to lift up about one-eighth of an inch against a platinum stop, and thus close the local battery circuit at each post. The automatic lighter being then supplied with current, immediately turns on and lights the gas. In a word, the system is merely a huge pneumatic push button, and corresponds precisely to pushing a button when desiring to light the gas in a house supplied with automatic lighters.

Figure 1 shows the lighter about two-thirds full size, in which P is the pressure gauge or gasholder sealed with mercury and held down by the weights W. When the gauge lifts, it closes the electric circuit through the magnet M; the armature A is attracted and caused to vibrate, throwing sparks at E and turning the ratchet wheel R. The first movement of the ratchet wheel admits the gas to a small auxiliary outlet at E,

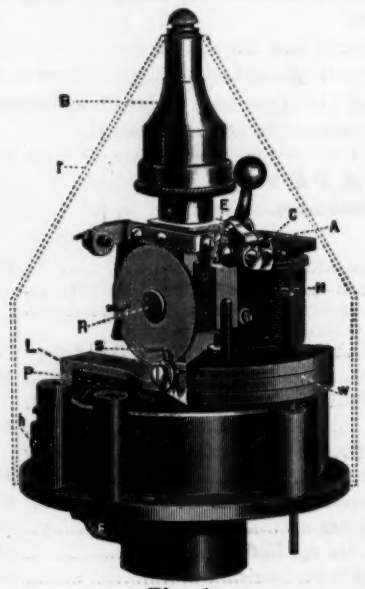

Fig. 1.

Fig. 2.

as well as to the main burner. The electric sparks formed at E ignite the auxiliary jet, which immediately shoots up and lights the main burner. As the ratchet wheel continues to turn, the auxiliary jet is closed, leaving the main burner open. The ratchet wheel is finally stopped with the gas turned full on and lighted, by a pin in the wheel striking against a stop S attached to the pressure gauge P.

It has been shown in practice that 15 seconds is amply sufficient for maintaining this increased pressure, to give time to make the increase everywhere felt. It can then be brought back to normal pressure, when the pressure gauge P will drop back and open the electric circuit. This operation, if repeated, will extinguish the lamps.

The mechanism of the lighter is extremely simple, and made so strong as to insure it from getting out of order or requiring attention of any kind. A heavy cast iron shell, 3 16ths of an inch thick, shown by the dotted lines in the cut, entirely surrounds the mechanism and protects it from all kinds of external abuse. No part of the lighter is exposed, except the lava tip, which is easily replaced should it become stopped up or broken. An outlet at P provides a passage for pouring in alcohol should the gas freeze in the riser pipe in winter. The iron battery boxes are supplied with covers flush with the ground, which are intended to

be removed once a year for cleaning the batteries. This operation constitutes the entire operating expenses.

The burner used is the sub-type, and gives a yellow flame without tongues and very little blue. It will consume exactly the number of cubic feet for which it is set under extremes of pressure varying from 1 to 5 inches of water.

Complete outfits of this system of gas lighting can be obtained by addressing the manufacturers, the Cutler Hammer Manufacturing Company, 247 South Jefferson street, Chicago.

The Stacking of Coal and Coal Haulage Machinery.

[Read by Mr. J. Chadwick, of Oldham, at the meeting of the Manchester District Institution of Gas Engineers.]

As time goes on, and members of Gas Associations continue to meet with increasing frequency, it becomes more difficult for those at the head of the various organizations to find new subjects to bring before the members for consideration, discussion and interchange of opinions. But it is not at all times necessary that we should have new subjects to confer upon, when we meet together to compare notes. Many old subjects we may revive, and look at them (it may be) from different points of view—approach them with a wider experience, a more extended acquaintance, and possibly with our knowledge more developed. Of the many subjects which have been brought before Gas Associations at various times, and which have been carefully considered from various points of view, the "storage of coal" has not by any means been neglected. Many gentlemen have, on different occasions, brought this subject before the various Associations with which they were connected, and it has been freely discussed. One of our own respected Past Presidents gave us a most valuable paper some time ago upon a somewhat similar subject. It is not, therefore, that I have any intention of, or am even capable of, introducing anything new on this subject that I have undertaken to bring it under your notice; but circumstances have occurred recently which caused me to think that it would not be an inopportune time to talk over this old subject once again.

It seems to me that the stacking of coal is, in future, likely to receive more consideration at the hands of large users of this commodity than has perhaps hitherto been the case. True, the importance of holding coal in readiness for cases of emergency by large consumers has not been neglected in the past, but what has been considered a sufficient quantity to hold for the temporary suspension of supply may not be considered adequate in the future. I need not go into the question as to the quantity of coal such industries as are represented by the iron trade, or the railway companies or steamship companies, or the many other branches of industry which are dependent on coal amongst other things to work their various concerns, their traffic, etc., should hold. Sufficient for present purposes to confine our consideration to what most particularly concerns our own industry—viz., the gas works of the country. I think I may safely say that it has been generally, if not universally allowed, that it was desirable (nay, even necessary) to have on our works a stock of coal at all times, to prevent serious inconvenience in case of any stoppage of supply. The quantity necessary to be held as a safeguard may have varied in the opinions of different people, and the geographical position of the particular works may have had some influence in determining what was a safe quantity to have.

The stacking of coal in most cases costs money; and the less we have need to stack, to be on the safe side, may be the most economical. A quantity equal to six weeks' maximum consumption has been generally considered sufficient to have in stock at any time; and naturally those who have adopted something like this quantity would have this stock at the commencement of the darker weather—say in autumn. Most of us who have been fortunate enough to have so large a quantity of fuel by us at that time have entered upon the time of heavier make of gas with complacency and composure, so far as the coal supply was concerned—thinking we should be able to meet all requirements; and generally we have been able to do so. But whether we shall consider such a quantity sufficient, or whether we shall place much reliance on our geographical position in the future, are matters which may be open to consideration and question. I am of opinion that many of us will take means to provide for storing coal in larger quantities than we have hitherto done. The stoppage of the coal supply from so large a portion of our coal fields, and the suspension of work extending for so long a time as has been the case quite recently, may well cause us to consider the advisability of holding larger stocks at our gas works.

Unfortunately, the relations between capital and labor in almost all our industries, are such that a cessation of work may be brought about upon large or small differences of opinion or action from either side. The recent stoppage of work in the coal trade shows us, among other things, the extreme difficulty of obtaining supplies of fuel under such circumstances. Although large stocks were held by many colliery proprietors, still there was great difficulty in moving them away. It may be said (indeed, it has been said) that if there had been no large stocks, there would have been no stoppage. That might have been the case; and it is not improbable that colliery proprietors will be unable in the future to accumulate such large stocks on their pit banks. But if the stocks are small, who shall say that a stoppage may not even then take place, or an advance in the price of coal be made to insure the pits working. Capital insisting on a reduction of wages to labor was the cause of the recent stoppage. The converse is just as likely to occur. Labor may insist on a greater share of proceeds than capital is disposed (or even able), for the time being, to grant, with similar results. From whatever cause the stoppage of the coal supply over a large area or for a lengthened period is brought about, besides the difficulties experienced in obtaining supplies, the result is a great advance in the price of the material. This was so in a marked degree quite recently; so much so that it is probable that many gas authorities will be obliged to advance the price of gas to their consumers, in order to recoup themselves for the extra expenditure thereon. It is hardly likely that disputes in the coal trade of such an extensive character will occur very frequently; but still disputes have occurred, and will occur at intervals. Can we not then mitigate the evils, and lessen the difficulties somewhat when a suspension of supply does occur, by holding larger stocks of coal than we have hitherto been in the habit of doing?

The saving of labor in every branch of industry has for many years past been the aim of mechanicians, as well as of those persons connected with and in charge of our various factories and workshops. A large quantity of work which to-day is done quickly, efficiently and economically by the aid of machinery, was formerly accomplished by hand labor only—necessitating an expenditure of more time and more money. No matter where we go, or where we turn in our busy hives of industry, labor-saving appliances meet us on every hand. The mechanical engineer makes special tools for various kinds of work required in his own business; the carpenter has his machines for planing, mitering, squaring, boring, etc.; the mason has the bulk of his rough and heavy work done by machinery; the textile industry has its many improvements in machinery for expediting the work performed; the bookbinder, the shoemaker, the tailor, and I might enumerate a great number of other trades whose work has been expedited and probably made more efficient and economical by the aid and use of machinery. It is not, therefore, surprising to find that the use of machinery in our gas works is extending. It may be said that its adoption has not been so general or so quick as it ought to have been. Still for many years the adoption of machinery has been the idea and aim of many people; and trials of various kinds of apparatus for working our retorts have been made. Some have been fairly successful and have been continued; others have shown room for improvement and have been modified and amended. Considering that machinery for this purpose has to undergo great hardship in its use—embracing rough handling and usage, great variations in temperature, and that it has to work in an atmosphere (more or less) of dust, dirt and smoke—I think we must allow that the retort stoking machinery of to-day has made considerable headway towards general favor and more extended adoption.

For the handling of coal and coke, the use of machinery is becoming a matter not only for consideration, but one that is being acted upon. The stacking of coal, for instance, may become a serious item (as to cost) in many gas works. When thousands of tons of material have to be put into our sheds every year, it becomes not only a question as to which is the cheapest way, but many times also which is the most expeditious. Gas works are differently situated, and exist under different conditions and circumstances in having to deal with their coal traffic. Some works have neither railway nor canal accommodation; and all their coal has to be carted into the works. Others will have railway sidings on the works. Some are in connection with canals or navigable rivers; but these will have the coal to move from the railway trucks or barges, as the case may be. The situation of the works, and the quantity of material to be dealt with, will have to be the factors which must help us to decide on the best and cheapest means of transferring the coal from the barges or trucks to the coal stores. If the works are small, and the quantity of material consequently not very large, hand labor may still be the best and cheapest means; but when there is so much material to move that it is possible to reduce the amount paid for hand labor by what will cover the interest on the cost of machinery, together with the wear and tear thereof, so soon I think it is advisable to consider

what kind of machinery will best suit the particular requirements, and to arrange and adopt accordingly.

A jib crane might be found sufficient in some cases; and it might be supplemented by the use of small tip wagons on an elevated roadway. Conveyers might perhaps come in to be useful and efficient. Elevators and conveyers combined might still better meet particular requirements; or other means might be devised to suit the particular place to be dealt with.

I purpose giving you a description of the coal haulage machinery I have erected at one of the works under my charge. At the works to which I refer, and which are known as the Higginshaw works, belonging to the Oldham Corporation, there is a branch railway running alongside the land; but it is some 21 feet below the level of the coal shed. By a series of inclines we get the coal trucks on to the same level as the shed floor, and alongside one end of it. Formerly the unloading of coal cost us about 8 cents per ton, by hand labor. Some four years ago, after carefully considering several methods for adapting machinery, I eventually came to the conclusion to adopt a system which would combine the breaking, elevating and conveying of the coal, so that I might be able to deposit it in any part of the shed.

I have two sets of breakers, elevators and conveyers, each a duplicate of the other; but they are separate and distinct, and complete in themselves, with the exception that the steam for working them is generated in one boiler. I shall describe one set of machinery and the working thereof: A 10 horse power horizontal steam engine running at about a hundred revolutions per minute, works the apparatus. The engine is geared to the coal breaker by steel wheels of double purchase. The breaker is composed of two cast steel rollers, with gripping teeth. Small coal passes between the rollers, while the teeth take hold of large lumps and break them. The elevator is fixed conveniently to take the coal from below the breaker to a sufficient elevation to carry it along the coal store. The hoisting apparatus is made for lifting a railway truck so that its contents may be emptied into a hopper immediately over the breaker. This hopper is capable of holding about 10 tons of coal. The hoisting gear is also arranged so that it may traverse along iron girders; and it is able to take hold of a wagon at either end. The conveyer is a band conveyer, composed of a number of thicknesses of cotton cloth stitched together lengthwise. It reaches from the top of the elevator, where there is a shoot to allow the buckets to empty themselves on to the conveyer; and the band reaches from one end of the shed to the other—a distance of some 200 feet—and travels about 190 feet per minute. A series of rollers carry the band and coal upon it, and the empty or return band is carried by another set of rollers. The band varies a little in length, according to the state of the weather and other circumstances; but an arrangement is made by which any variation can be taken up or given out as the case may be. There is also a throw-off carriage, which can be placed in any part of the shed, and which will then throw the coal off the band at that particular spot. At a convenient place a shaft is fixed to work in bearings attached to wall brackets, and on this shaft there is a pulley which carries the main driving belt from the engine. There are also pulleys to work the wagon hoisting and traversing gear, with open and crossed belts for working in different directions. These belts are controlled by strap guiders, worked by chains, and are under easy control of the workmen. The elevator is worked by a sprocket wheel fixed on this shaft, and a pitch chain passing over another sprocket wheel at the head of the elevator. Sprocket wheels and chain also work the conveyer.

In working, the railway trucks are brought over the hopper, and the truck is then taken hold of by the hoisting gear and one end lifted. The door being opened at the other end, the coal falls into the hopper and through the breaker into the pit at the bottom. The elevator buckets are working through this pit, and scoop up the coal and raise it to the head of the elevator, where it is thrown into the shoot, guided to the conveyer, and taken to any part of the shed required.

We have had this machine working now for more than three years; and I am pleased to say that it has worked exceedingly well.

I think that this was about one of the first installations of machinery for the specific purpose of unloading and stacking of coal; and the amount spent in repairs and maintenance up to now has been practically *nil*. The wear and tear is not nearly so much as I anticipated. We find a monetary saving by its use; and this saving will be greater as more material is required, because the machinery is capable of doing three or four times the work we have at present for it to do.

The total expenditure on the machinery and for alterations incidental to its erection, was $18,500. The amount of money spent in wages last year for unloading 34,000 tons of coal was $1,650 less than the amount spent on a similar quantity of material previous to the erection of the machinery. If we reckon 3½ per cent. interest on the outlay and 2½ per cent. for wear and tear, we have a charge of $1,065, which leaves us a saving of $585 yer annum. But we might reckon 5 per cent. for wear and tear, which, with the charge for interest as before, would make a sum of $1,525, still leaving $125 to the good. But as I have already said, we have expended very little on repairs yet, and I think that the 2½ per cent. will cover everything in the shape of wear and tear that will be required. The expenditure on coal, coke, water and oil to work the apparatus comes to about $2.50 per week.

We also find it most convenient and expeditious in its working. Most of you are aware that traffic does not always come along very regularly. In the winter months for instance, when foggy weather prevails, it often happens that traffic is detained; and then when the weather clears somewhat a sudden inrush of wagons comes—occasionally two or three days' traffic all at once. We can deal with this without much inconvenience. We have on many occasions taken such a quantity of material in one day with very little extra trouble.

You will notice that in the arrangement of the machinery I have been describing, the movement of the coal is all in one direction. But this can be altered and arranged to suit any particular requirement.

Many gentlemen connected with gas works in various parts of the country have been to see this machinery working. Some are members of this Institution, and they may perhaps give us their impressions thereon. I understand that some were so satisfied with their visit, that they are contemplating the erection of machinery of a somewhat similar character. Amongst others, I may mention the neighboring town of Bury, where the Gas Committee, after very careful consideration, and under the recommendation of their Manager, have decided to erect, and have now in hand, an installation of coal-haulage machinery on similar lines, and for a like purpose—viz., stacking coal in their shed. I hope they will find as much benefit from its application as I have from the one I have been describing to you.

[By the kind permission of Mr. West, one of our members, I am able to show you a few drawings where this system is made to suit various requirements.]

The Plymouth Gas Company are about to erect at their works a plant by which they anticipate being able to dispense with a considerable amount of labor in transferring coal from ships to their store. The Gas Light and Coke Company also have had machinery for coal haulage erected at their Kensal Green works, and so far as I learn with satisfactory results. This conveyer, however, is somewhat different in construction to the one I have been describing. I think therefore we may conclude that coal haulage machinery in our gas works is on the increase; and ere long we may hope to have other information which will help us to a more general knowledge as to the economics thereof.

Before I close my paper, I may perhaps say one or two words about the application of machinery for the haulage of coke. This also is receiving great attention at the hands of gas managers; and coke conveying plant has already been erected at several gas works—Birmingham, South Metropolitan and Melbourne being amongst the number. For moving coke, I think machinery will become more extensively used, because it not unfrequently happens that coke has to be piled up to a great height, and this becomes a matter of considerable expense. With the machinery, however, as now made, coke as it leaves the retort house can be taken into store to any reasonable elevation, or it can be deposited into hoppers ready for immediate delivery into carts, barges, or trucks, as the case may be. I believe our President (Mr. Chester) contemplates the erection of coke conveying plant, with breaking and washing apparatus combined, by which means he will be able to prepare his coke to suit the special requirements of his district.

I have here a drawing showing an arrangement for coke conveying, elevating, stacking, screening and filling into wagons or sacks. You will observe that the coke, as it is drawn from the retorts, falls on to conveyers, which carry it to a pit about the center of the retort house. This is a metallic conveyer, formed of iron or steel plates; and the hot coke, on its way to the pit, is quenched with water. From the pit it is elevated and then conveyed into the yard for storage, or placed into hoppers or railway trucks, or conveyed into screens which clean and sort it to various sizes, when it may be put into sacks ready for sale.

The introduction of inclined retorts has brought coal elevators and conveyers more into use; and this system of carbonization seems to lend itself readily thereto. Many places where this system is working have some kind of coal haulage machinery in connection therewith.

Well, gentlemen, I think you will agree with me that there are sufficient examples of machinery at work for transporting materials in our gas works to warrant us in saying that it has got beyond the experimental stage.

The Use of Small Sizes of Anthracite Coal for Generating Steam.

[From the Address of President E. B. Coxe, at the Annual Convention of the American Society of Mechanical Engineers.]

When I first remember the anthracite coal business all the sizes below stove coal were considered of little or no value. Chestnut coal was used to a greater or less extent about the collieries for making steam, but much of it was thrown away. It gradually became a domestic fuel, and pea coal took its place for generating steam. This size is gradually coming into use for domestic purposes, and buckwheat coal is taking its place for steam. Two smaller sizes, known as rice and barley, are already being used to a large extent for the same purpose. The value or cost of these coals decreases very rapidly with the size. I append here with a table showing the size and approximate cost at mines, and the sizes of mesh over which or through which they are made.

Table 1.

Size.	Made Through. Inch.	Made Over. Inch.	Approximate Price at Mines.
Chestnut	1½	⅞	$2.75
Pea	⅞	9/16	1.25
Buckwheat	9/16	⅜	.75
Rice	⅜	9/16	.25
Barley	9/16	3/32	.10

NOTE.—The above meshes are all round punched, and are the standards adopted by Coxe Bros. & Co. at the Cross Creek Collieries.

Another important point to be noted is that the cost of transportation of the small sizes is less than that of the large. From the mines to tide pea coal is charged 30 cents and buckwheat, rice and barley 50 cents less per ton than the domestic sizes.

One great difficulty encountered in the introduction of these smaller sizes was the fact that, as they were of comparatively little value, but little attention was paid to their preparation, and parties who began to use them did not erect furnaces specially constructed for the purpose, but generally burned them in their old plants, sometimes changing the construction of their grate bars a little.

While the sizes of the domestic coals made by the different companies are practically the same, there has been a great difference in that of the small coals and in the amount of impurities contained in them. Formerly a large amount of culm was employed where it could be obtained cheaply, but its use is diminishing for the following reason: What was formerly known as culm contained the buckwheat, rice, barley, and in some cases the pea coal. Now, however, the pea, buckwheat, rice, and in some cases the barley, are taken out; and the dust that remains, which forms what is now called culm, although it may still be used by mixing with bituminous coal, or in a special furnace in which it is burned as dust after being thoroughly pulverized, or by making briquettes or compressed fuel, yet it is at present of no value alone and in its natural state for generating steam.

As is well known to all those who burn anthracite, sizing is of great importance. The coal burns only on the surface, and, therefore, if the size is not uniform, the smaller particles clog the passages between the larger and thereby prevent a sufficient quantity of air from passing through the furnace. Some of those who have attempted to use buckwheat, rice and barley have given them up, because of the great want of uniformity in the results obtained. The difficulty may be due to one of two causes, or both: 1, to bad sizing, and, 2, to the presence of a large quantity of impurities. Experiments we have made have proved that the percentage of carbon when small anthracites are burned under proper conditions, and not the size, is what determines the amount of water evaporated per pound of coal, but the amount of water evaporated per square foot of heating surface decreases with the size of coal.

Of course it is not practically possible to have the size of the coal absolutely uniform, but the producer should at least guarantee that a certain percentage of the coal sold as rice should be of such size that it would pass through a mesh of a specified diameter and over a mesh of another specified diameter. In other words, with the present light I have upon the subject, if I was in charge of a large steam plant burning, say, 100,000 tons of rice coal per year, I would try to make a contract which would require the coal to contain not over a certain percentage of water and not less than a certain percentage of carbon, or, what is practically the same thing for anthracite, not over a certain percentage of ash, and that a certain percentage of the average daily sample of the coal would pass through a mesh of a certain size and over a mesh of another size, and that the coal should not contain more than a certain percentage of dust—dust being what would pass through a mesh of, say, 1/16th inch in diameter.

Having reached these conclusions some time ago, I have, with my assistant, John R. Wagner, been studying the questions of how to determine in a rapid, simple and effective manner, by methods which do not require scientific work except for the analysis of the coal, the actual commercial value of any shipment of these small sizes.

I shall now proceed to describe our methods for doing this work.

As we are producers to a much larger extent than we are consumers of the small anthracites, although we burn between 100,000 and 150,000 tons per year at our colleries and works for generating steam, we have taken up the subject with the view of controlling our production as well as controlling our consumption, and I shall describe our methods of doing the work, which can easily be adapted by any one receiving coal in cars or boats to their special case.

The foundation of all such work is the obtaining of fair average samples. This is done as follows:

At each of the colleries where the pea, buckwheat, rice and barley are shipped samples of each size are taken several times a day from the loading lips as the coal is running into the cars. These are put into four separate bins, one for each size. At the end of the week the coal in each bin is thoroughly mixed, and is then sampled by quartering down until we obtain about 30 pounds, which is sent in a strong canvas bag to the laboratory, thus obtaining from each breaker an average sample of each of the four sizes each week.

The work of taking samples is under the direction of the coal inspector (one being stationed at each colliery), who inspects all the coal shipped. When cars of small capacity are loaded, of which there are not many now, the samples are sometimes taken from the top of the cars instead of taking them from the lips as the coal runs into the cars. With cars of larger capacity the samples are always taken as the coal runs from the lips, getting in each case a very fair average. In taking samples from the top of the smaller cars, eight or ten ordinary buckets of coal are taken from different parts of the car without paying any special attention to character of the coal at the place it is taken. The coal from the buckets is placed on a platform and quartered down until about one bucketful is obtained, which is put in the bin. In the other case, where the samples are taken as the coal runs from the lips, they are also put in a bucket and carried to the proper bin. Each of the samples obtained may be used for any of the five following operations:

1. Determination of size.
2. Determination of the slate.
3. Determination of the ash, involving in some cases an analysis of the ash.
4. Determination of the water.
5. Rapid commercial determination of the specific gravity of the coal.

Determination of Size.—The object of this operation is to determine the exact size of coal which makes up the sample, as distinguished from its nominal size. The apparatus consists essentially of a cubical box, the top and one side of which are open and into which slides a series of drawers. We generally use five or six. These drawers are wooden frames 1¼ inches deep, about 12 inches wide and 14 inches long.

The bottom is a sheet of perforated metal. The box rests upon a circular base of wood, which is coned at the bottom and has in its center a pin with a spherical head, which works in a spherical hole in the center of the wood base. When the pin is placed in the center hole the box can be revolved easily, and in such a way that the axis of the box describes a cone. This shakes the coal and causes it to move from one side of the screen to the other, and, as it can be moved very rapidly, soon sizes the coal. When the drawers have been placed in the box a stick of wood is inserted to prevent the drawers from sliding out. The sizes of the perforations which we usually employ are:

For the upper screen, ¼ inch round.
For the next lower, 9/16 inch round.
For the next lower, ⅜ inch round.
For the next lower, 3/16 inch round.
For the next lower, 3/32 or 1/16 inch round.

This makes with the dust six sizes. Of course the number of drawers and the size of the perforations can be varied to suit each special case. If the coal is of the ordinary character we can screen about 15 pounds, or about one-half the regular sample brought to laboratory, which is quartered down to obtain the amount necessary to make the determination. It is not necessary to weigh the part to be tested; it is, however, necessary that the entire sample obtained by quartering down should be screened, otherwise you would not have an average sample.

The coal is gradually poured upon the screen while it is revolving. When the operator is satisfied that the coal is thoroughly screened, each drawer is taken out and the quantity in each drawer is weighed, and by simply adding together these weights, the total weight of the sample is

obtained. In this way the average percentage of each size is easily found.

Determination of Slate.—While in large coal the percentage of slate can easily be determined by taking the average sample, weighing out say 100 pounds of it, picking it over by hand and weighing the amount of slate and bone found, it becomes very difficult to do this with the smaller sizes of coal, as a magnifying glass must be used. This is very trying on the eyes, and requires a great deal of time. We sometimes resort to it, but only for the purpose of checking our other process. The method adopted depends upon the difference in the specific gravity of the coal and slate. The specific gravity of a piece of coal increases with the amount of ash that the coal proper contains, and also with the amount of bone or slate attached to it.

We first determine by analysis the composition of the coal, bone and slate from the mine we wish to study, and also find in the usual way the specific gravity of the specimens analyzed. We thus fix a limiting specific gravity, the particles lighter than which may be considered coal, and those heavier slate or bone; and we make a solution of chloride of zinc of the same specific gravity. This limiting specific gravity, of course, varies with the nature of the coal and the nature of the impurities. The coal from the Lehigh region and some parts of the Schuylkill region is much heavier than that of the other parts of the anthacite field, and the specific gravities of the bone and slate also vary with the locality and vein. We use for our mines a solution with a specific gravity varying from 1.70 to 1.72.

The simplest form of the operation would be to take a large beaker glass nearly filled with the solution of chloride of zinc, and pour slowly into the coal to be examined, stirring it from time to time. The coal floats and the slate goes to the bottom. When the floating coal, which is generally much greater in quantity than the slate, begins to cover the top of the vessel, a portion of it is skimmed off and put in a dish; and this is continued until all the coal to be tested has been poured into the vessel. The remaining coal which is floating is skimmed off with a great deal of care, the chloride of zinc solution is poured off, and the slate placed in another vessel. The coal and slate are then washed and dried and weighed, and the percentage of each calculated. This, of course, does very well if only a few determinations are to be made, but where it is necessary, as with us, to make a large number of tests, an apparatus devised to simplify the work may be used with advantage.

As we have constantly occasion to dry coal, which in the ordinary way takes considerable time, a simple apparatus was erected to do the work. It consists essentially of a rectangular iron case about 4 feet long, 26 inches wide and 4 inches high, cast hollow and as thin as possible. This is kept filled with steam; on top of this is placed a box made of wood, in the bottom of which there are two drawers 18 inches long and 16 inches wide. The sides of these drawers are of wood and the bottom of 24-mesh wire gauze. The bottom of the box, which is about 1 inch thick, covers the whole iron plate, and extends about 1½ inches beyond the edge all around. From the outer edge of the cover a canvas curtain about 8 inches long is hung. The drawer is about 1 inch above the iron plate, leaving space for the hot air to pass through. The bottom of the case is cut out where the bottom of the drawer is covered with the gauze, and the whole box rests upon the plate, so that air passes around and over the plate and up through the gauze. The top of the box is closed, with exception of one hole, in which is inserted a sheet iron pipe, which connects with a suction fan. The result is that a constant supply of air passes around the iron plate, through the holes in the wood cover, and then through the gauze to the suction fan, by means of which a very rapid drying at a comparatively low temperature is brought about. In order to dry the coal and slate from the chloride of zinc apparatus, the pipe between the drying apparatus and the fan is enlarged, so that, by removing the cap on the upper part of the enlarged portion of the pipe, the cylinders can be inserted in the enlarged portion, the cover put on, and the drying of this coal and slate carried on without interfering with the drying in the other part of the apparatus. This apparatus is very simple and inexpensive, and is very satisfactory and thorough in its work.

Analysis of the Ash.—The sample which comes from the colliery in the canvas bag, on reaching the sample room of the laboratory is divided into two parts, one of which is dried (should it be wet) in the apparatus already described, and then goes to the pulverizer. The pulverizer consists of a cast iron cylindrical shell, 12 inches long and 16 inches in diameter (both inside), through the center of which passes an iron shaft, and inside of it are 16 chilled cast iron balls 3 inches in diameter. The cylinder makes from 70 to 150 revolutions per minute, according to the number of samples to be prepared. Along the surface of the cylinder, and parallel to the axis, runs a slot which is ¼ inch wide on the inside and 1½ inches wide on the outside. This is closed by a wrought iron wedge, which is held by two clamps placed near each end. The coal is introduced by bringing the slot to the top and pouring it in, and is removed by bringing the slot to the bottom and allowing it to run out, the cylinder being oscillated backward and forward in order to remove all the stuff, which is received in a Russia iron pan 24 inches long and 18 inches wide. In this way practically the whole of the pulverized product can be rapidly removed. We generally put about 15 pounds into the pulverizer at once. Running at a moderate speed it takes about 1½ hours to pulverize 15 pounds of pea coal thoroughly; but, by crushing it in a mortar so that the coal will pass through a $\frac{3}{16}$ round mesh, this time can be very materially reduced. Buckwheat, rice and barley are pulverized without any previous hand crushing. Rice and barley require only about three-quarters of an hour.

The pulverizer is a very simple, cheap and effective machine. The surfaces of the slot are planed, as is also the wedge, making a perfectly tight joint, and not allowing any dust to escape.

The pulverized coal received in the pan is quartered down to about 1 pint, which is screened on a No. 60 mesh sieve; 90 per cent. generally passing through; and that which does not pass through is crushed finer by hand on a rubbing plate, requiring but a few minutes.

But attention having been called to the discrepancies in analysis where we attempted rapid crushing, we made a series of careful experiments (the results of which are given in the following table) to satisfy ourselves as to the facts. The first column gives the sizes of coal, the second column gives the percentage of ash when the proper method of sampling is adopted, the third column gives the results when the rapid method of sampling was adopted, and the fourth column gives the difference in each case.

Results of Comparison of Two Methods of Obtaining the Powdered Samples, for Analysis.

Size.	Method "A." Per Cent. of Ash.	Method "B." Per Cent. of Ash.	Difference. Per Cent.
Lump coal	5.00	6.65	1.65
Broken coal	7.52	9.97	2.47
Egg coal	8.50	11.12	2.62
Stove coal	8 39	10.15	1.76
Chestnut coal	9.50	12.87	3.37
Pea	11.45	14.95	3.50
Buckwheat	9.87	11.27	1.40
Rice	13.85	17.95	4.10
Barley	13.05	23.95	10.90

It will be observed that the difference was as much as 84 per cent. in the last case. The reason of this is probably that a large portion of the impurities in coal, such as iron pyrites, silica and substances of a clayey nature, occur in very light incrustations upon the surfaces of fracture of the coal.

Proximate Analysis of the Coal.—For commercial purposes, which is the point of view from which I am treating this subject, only a proximate analysis of the coal is generally necessary—that is, an analysis by which the moisture, volatile combustible matter and ash are determined, the carbon being determined by difference. It is necessary only occasionally to determine the sulphur, and more rarely the composition of the ash, as the sulphur and the composition of the ash do not vary in the coal from one colliery as much as the percentage of ash. It would not be necessary to determine very often the moisture and volatile combustible matter were it not that without them the amount of fixed carbon cannot be arrived at.

The sample, which has been pulverized and quartered down until it will about fill a pint measure, is sent to the analytical room, where it is subjected to the following operations:

1. Determination of ash.
2. Determination of moisture.
3. Determination of volatile combustible matter.
4. Determination of sulphur.
5. Analysis of ash.

Moisture Determination. This is done in a very simple apparatus constructed as follows:

Two 1-inch boards, 12 inches wide and about 8 inches high, with the upper corners rounded off, form the back and front. In each of these boards there is cut an opening 10 inches wide and 4½ inches high, also rounded, in which there is placed a copper muffle made of sheet copper $\frac{1}{16}$ inch thick, simply bent in the form desired and riveted at the joint, and open at both ends. This is tacked to the two boards. Both the front and back of this muffle are closed by a piece of asbestos board supported on two tacks. Another piece of asbestos board is bent around so as to form the sides and top, leaving a space between it and the muffle

about 1 inch wide. Underneath the muffle are three very small gas jets formed by making three small perforations in ⅛-inch gas pipe. These give the heat which keeps the muffle hot. A thermometer passes through the top of the muffle and the asbestos board top, and shows the heat in the muffle. The piece of asbestos board at the back is not taken off; that in front is removable in order to allow the sample to be put in. By means of these gas jets the temperature is kept at about 225° F., and remains remarkably constant with but very little attention. Any ordinary mechanic can construct this apparatus in a few hours.

The sample when weighed out is placed in the muffle, and remains at a temperature of 225° for about one hour, experience having shown us that this time and this temperature are best suited for determining the moisture in our anthracites. Notwithstanding the extreme simplicity and low cost of the apparatus, it gives results which are very satisfactory.

Determination of Volatile Combustible Matter.—For this determination, the method usually adopted is to heat the sample in a covered platinum crucible for 3½ minutes by an ordinary bunsen burner, and then, without cooling, for 3½ minutes more with a blast burner. We find it very convenient to adopt a crucible of special shape provided with a flanged sleeve. The crucible is 1 inch in diameter, 2½ inches deep, and cylindrical for the length of 1¾ inches. It has a wire rim at the top, and fits loosely into a sleeve which bears against the rim. The sleeve is beaded on top to keep it cylindrical, and ½ inch below the top of the sleeve there is a thin annular disk of platinum, which is fused to the other part of the sleeve. The crucible, with this thin sleeve, is supported by a platinum wire triangle placed over a clay cylinder, and which in its turn is supported by a ring of the filter stand at a height suitable to the height of the burner. The clay cylinder is 3¼ inches high, with a hole 2 inches in diameter at the top, and tapering down to $1\frac{5}{16}$ inches at 1 inch from the bottom, and from there down widening out again to 1½ inches. The sleeve prevents the crucible from slipping through the wire triangle or the holes in the desiccator and from tilting over on the wires. It also helps in heating it to the highest possible temperature for the full length, as it baffles the flame. This sleeve is also very convenient for lifting the crucible from the cylinder into the desiccator, and from thence into the scale pan, as the operator simply grasps the disc of the sleeve with an ordinary pair of forceps. It weighs 9 grammes. We also use the same crucible and sleeve for fusions when making complete analyses of the ash.

Determination of Sulphur.—This is done by Eschka's method, with one exception; that is, we use a different form of crucible, in the shape of a small lipped and wire rimmed beaker of platinum, holding about 3½ times as much as the ones usually employed. It is 2½ inches high, 2 inches in diameter, and tapering slightly toward the bottom. By using a larger crucible all the operations of oxidation, acidulating, oxidizing with bromine, and driving off excess of the latter, etc., can be performed without transferring or washing the beaker, this saving considerable time.

Analysis of the Ash.—This, of course, is a comparatively long operation, and is done in the ordinary way.

Rough Determination of Specific Gravity.—This, though a comparatively simple and to all appearances rough operation, promises to be of value to producers and users of anthracite coals. The apparatus we employ is constructed as follows:

It consists of four parts, an ordinary sheet iron bucket such as is used about the works for sand or ashes, and holding about 25 pounds, an ordinary washtub, a Fairbank's market beam scale and a cylindrical tin pan about 14 inches in diameter and 7 inches deep.

The weighing beam is attached to the post by means of a small crane, which throws it out from the post. The ordinary hook used for suspending material to be weighed carries a yoke, from which the tin pan is suspended by two wires. The bucket is also hung on the same hook.

The tub is then filled with water until the tin pan is covered, and the whole is then balanced by means of a weight hung on the outer end of the beam, which weight remains constant. The poise used for weighing moves along the beam in the ordinary way. The beam is divided into pounds and quarter pounds, each notch representing ¼ pound when the ordinary poise is used. In order to weigh to $\frac{1}{100}$ pound, a little rider made of sheet metal, and of such a weight that each notch represents $\frac{1}{100}$ pound, is used, so that by placing the poise in the notch corresponding to the even pound, which is just less than the actual weight, and then moving the rider until the beam balances, and reading off the number of notches, the actual weight in pounds and $\frac{1}{100}$ pounds is obtained. If, for example, the rider is in the second notch to the right hand of the 10 pound notch, it would read $\frac{42}{100}$ pounds; that is, the 10 pounds would represent 40 notches, which with the other two would make 42.

When the average specific gravity of a shipment of coal is to be determined specimens are taken from all parts until a fair average sample is obtained. This is spread on a platform and quartered down until the material is reduced to about 20 pounds, which is then put into the bucket.

If we know the average specific gravity of the sizes below egg coal from a certain colliery, and their average percentage of ash, by merely getting the specific gravity of the coal in a number of cars we can determine satisfactorily (we are inclined to think) the percentage of ash by the following formula:

$$y' = y + (x' - x) \times a;$$

in which

x = the standard specific gravity,
y = the standard percentage of ash,
x' = the specific gravity of coal determined by our apparatus,
y' = the percentage of ash to be determined,
a = a constant for coal from same mine.

We have become so thoroughly impressed with the importance of having the specific gravity of all samples of coal which we analyze, that, whenever the sample sent to the office is large enough, we obtain the specific gravity in the rough way given above, and find that it adds very materially to the value of the data obtained by analysis.

It seems to me that in all important boiler tests not only the coal used should be analyzed, and a special determination made of the amount of moisture in the coal when it is actually fired, but also that the ashes should be carefully analyzed. The sample for both the analyses should be obtained by quartering down all the coal to be used, and quartering down all the ashes made.

There is another question of very great importance to users of coal, on which I am not, however, ready to say much—that is, the clinkering. It depends, undoubtedly, upon two points: the temperature at which the coal burns, and the composition of the ash. The fact that a coal does not clinker may be due to its impurity; that is to say, the coal may be so impure that it will not make a fire hot enough to melt the ash, although the composition of the ash may be such that were it contained in a pure coal it would melt easily. On the other hand, the coal may clinker because it is very pure and burns at a very high temperature.

The Widening Use of Compressed Air.

[By Mr. Whitfield Price Pressinger, in *Engineering Magazine.*]

Although considerable attention has been devoted of late in the technical press to compressed air and improved types of air compressing machinery, few have paused to consider the multiplicity of duties to which this power is applied, and the variety of work in the successful performance of which it is an important factor. This development is interesting in a general point of view as a feature of modern progress, and the control of this air, which the child uses to actuate his pop gun and the aborigine in Thibet employs to produce light, is fast becoming a power in the commercial world.

Compressed air, utilized for power purposes, either locally or at a distance, has been known to the world for nearly 200 years, Dr. Peppin, an eminent French engineer, having conducted some experiments with it in the early part of the eighteenth century. It has been more or less identified with almost every prominent engineering work in America in modern times, furnishing as it does a means of transmitting power a long distance from its source, without the heavy losses from condensation attendant upon the use of steam; or supplying the power for sinking a bridge caisson without interfering with the duties of the workmen inside; or permitting mines to be worked at levels where the use of steam would be impracticable, the exhaust air having a marked effect upon the temperature of the mine. But the employment of compressed air for sinking bridge caissons, operating rock drills, coal cutters, and other mining machinery, manipulating air brakes, tunnel driving by the pneumatic process, etc., are familiar ones, and passing mention of them will suffice in a summary of the various uses which have been devised for this power and the service it is performing for the engineer, scientist and manufacturer.

The pneumatic dynamite gun is a familiar example of the duty which is made possible by air under pressure. The pent up energy which, when released under a pressure of 2,000 to 3,000 pounds per square inch, hurls a projectile containing 500 pounds of nitro-gelatine and dynamite through a mile of space in 18 seconds, with an initial velocity of 800 feet per second, is a powerful factor in the art of war.

Another employment of comparatively recent development—but designed for the preservation, not the destruction, of life and property—is the pneumatic device for block signaling. In this duty the compressed

air is supplied from a central station, and each semaphore or signal-arm is operated by a separate cylinder and gear fitted to the signal post, the valves of the apparatus being controlled by electricity. In some instances the air is carried in 2-inch pipes to a distance of nearly 8 miles from the point of supply, the pipes on the main road being supported on stakes along the track. When it is necessary to pass through yards the pipes are carried underneath the ballast of the road. The air pressure maintained is about 60 pounds per square inch.

The method of raising water from deep wells by means of compressed air is one that has recently commanded attention, and many of our largest factories and mills have discarded deep well pumps and become dependent upon their air compressors for their entire water supply. Indeed, so successful has been the work done by this system of raising water that one manufacturer whose neighbor had introduced it found his entire water supply diverted, and was compelled to adopt the compressed air method or close his works. The plan is that of the siphon, and consists of little else than two plain parallel iron pipes inserted into the well, one acting as an inlet for the compressed air and the other serving as an outlet for the water, which is expelled in a solid column. The pressure of air used is of course directly proportionate to the depth of the well. Results differ as to the exact saving in power and repairs in comparing this method with the best deep-well pump practice, but in an individual instance a daily water supply of 300 gallons was secured against a former possible supply of 75 gallons. The average efficiency of the deep-well pump is 30 per cent., whereas as high as 70 per cent. is claimed for the compressed air method.

The utilization of crude petroleum for fuel purposes affords another example in which compressed air is highly necessary. The air is used at a pressure of 10 to 15 pounds per square inch, and sprays the oil into a jet at the point of consumption. This system is utilized in about 50 different varieties of work, such as iron and steel forging; tempering, welding, annealing, making tin plate; for furnaces, glory holes, lears and ovens; in glass and pottery works; japanning, and heating retorts in gas works. In all of these plants the air compressor is a very important adjunct, for without it they cannot be operated.

The chemical manufacturer finds compressed air a valuable servant in emptying tank cars containing acids, and forcing their contents to various parts of his works. He also employs compressed air to agitate and cool his solutions. The sugar interest is also a large user of compressed air for agitating and cooling syrups.

In india rubber factories the hose is removed from the iron mandrels by forcing a current of air under 50 or 60 pounds pressure between hose and mandrels, thereby inflating the hose, and permitting it to be easily slipped off. The hose manufacturer also uses compressed air for testing his product, a test as high as 1,000 pounds pressure per square inch being demanded on some varieties. A new plan which has lately been adopted in silk mills is the spraying of solutions on silk ribbon by means of compressed air under 40 pounds pressure. This system is highly successful, as it possesses many advantages over old methods and is rapidly being introduced by the manufacturers.

Pneumatic riveting machines are to-day used in all construction works of any size, this being another form of operating with compressed air, where the exhausting steam would render the use of the latter impossible. In the same manner compressed air is used in boiler shops for operating tapping and calking tools and portable drills. It is being widely introduced into monument and architectural stone works for operating pneumatic carving tools, the latter being immeasurably superior to hand tools, both in the saving of time and in execution.

Pneumatic cranes and hoisting machinery open a very large field of usefulness for compressed air, for establishments are found in every branch of trade equipped with apparatus of this description. As an instance I would mention the Armour abbatoir, in Kansas City, which conveys animals through all the various stages of slaughtering, cleansing, dressing, etc., entirely by this method; and many other industries employ it to a like extent. The piston and cylinder hoist, with its various modifications, is used.

The numerous systems of pneumatic tubes for transmitting mail matter and other parcels by air pressure have been too thoroughly described to require more than mere mention, but the plant installed in the Philadelphia Post Office is only an entering wedge to what, it is believed, will eventually be adopted by the Government. In this service we are far behind our foreign cousins, who have had numbers of such plants in operation in London, Paris, Berlin, and other cities for years, there being about 50 miles of such tubes in Great Britain alone.

Among the oldest forms of employment of compressed air are those to be found in refrigerating and ventilating. Ammonia has supplanted air for the former duty, but the various new systems and improvements of old systems of ventilating recently introduced bid fair to solve the problems which have so long vexed ventilating engineers and incidentally to bring compressed air into further prominence as a servant and benefactor of mankind.

The propulsion of cars by compressed air is another source of utilization of this power which has received the attention of engineers for some years past. The Mekarski system, which has been operated so successfully in Paris and other European cities, has been introduced into this country, and the Judson, Kames, and other systems are more or less known. A compressed air motor needs no conduits or overhead contrivances, does not emit smoke or hot gases, and is almost noiseless. It is very light and can easily be handled on the steepest grades. It is simple in form and does not frighten horses, the machinery in front being almost invisible from outside. With the increasing efficiency of the best types of air compressors, and the resultant economy in compressed air production, the cost of this system is gradually approaching the most favorable comparison with other methods of street car propulsion.

A recent application of an old principle is a pneumatic culm conveyer, designed to remove culm from the coal breaker and convey it to any desired point by directing a current of compressed air into the receiving pipe. If the air be heated it performs the further duty of separating the dust from the small pieces of coal. Pneumatic grain elevators, operating on a similar plan, have been used to a considerable extent in England, and to a less degree in this country. A plant of this kind at Birmingham has tubes of various dimensions, and a capacity of 25 to 60 tons per hour. The chief feature consists of the peculiar shaped nozzles through which the grain is drawn and forced upward at an enormous rate. Operating under 40 pounds pressure the grain is raised to a bin at a height of 40 feet, descending thence into a weighing device. The cost of unloading grain cargoes by this method approximates 4 to 6 cents per ton.

The system for the disposal of sewage by air under pressure has palpable advantages under certain conditions. In the plant at the World's Fair, with which many of my readers are no doubt familiar, the territory is divided into sections, each having its own ejectors, into which it drains. These ejectors operate alternately, the pressure being turned on and off by automatic valves and the contents forced to their destination through cast iron mains.

Another utilization of compressed air at the World's Fair was that of painting the large buildings by means of a spray, the air forcing the paint through a hose to a nozzle which is handled by the painter instead of his brush; playing away at the object to be painted much after the manner of the gardener on the lawn. In the dome of the Horticultural Building the painter stood about 70 feet above his source of supply, and a large amount of space was covered in an incredibly short time by this method.

The Australian sheep shearing machine is another mechanical device operated by compressed air. It is claimed for this machine that a hundred sheep can be sheared in the time formerly required for 70, that the value of the wool is enhanced by its use, and that the animal is never mutilated. It operates at 40 pounds air pressure, and makes 6,000 revolutions per minute, the exhaust air preventing the generation of undue heat.

An application of another old idea depending upon compressed air for its success has recently been attempted—that of raising sunken vessels by placing collapsible india-rubber bags in the hold of the vessel and connecting these bags by means of hose to an air compressor located upon a tug at the surface. When the bags are inflated to a pressure of 60 to 80 pounds per square inch it is claimed that enough water is expelled from the hull of the ship to restore very nearly its original buoyancy. The schooner *Glenola*, sunk off the Long Island coast, was recently raised by this method. It has been proposed to adapt this same principle to all new vessels by dividing each ship into airtight compartments, with doors properly packed, each compartment being supplied by a tube from an air compressor. With a suitable system of switches the water could be ejected from any compartment should a leak become manifest on an electrical indicator in the switch room.

In the purification of a city's water supply compressed air is used largely. A plant was installed by Professor Leeds, at Hoboken, in 1884, the air being used at 128 pounds pressure. Since that time companies (now merged into one) controlling the various existing methods of purification have established plants in many cities and towns in the United States.

A large number of experiments with compressed air are continually being tried. Among the uses which have never been reduced to the practicability of commercial requirements, I am reminded of an exper-

iment which was tried some years ago, before the small steam racing crafts of to-day were contemplated. A steamer was seen one day to pass through the Kill von Kull at the then extraordinary speed of 25 miles per hour. This was accomplished by means of two air compressors pumping air beneath her hull, thereby imparting great buoyancy. Unfortunately the swell from her rapidly revolving paddles was so great as to wash over piers and wreck small boats, and it was even alleged that it injured oyster beds in the vicinity. A drag was adopted to keep down the swell, but the expense of operating in this manner was too great, and the project was abandoned.

In addition to the various applications of compressed air already enumerated, it is employed to operate the steering gear of vessels, to supply divers in submarine operations, to mold patterns in foundries, and a Western railroad is reported to clean the seats of its passenger cars with jets of compressed air. Physicians use air largely for treating patients by means of a spray, and hospitals are equipped with chambers in which the patient breathes air pumped in at a pressure of 30 to 40 pounds per square inch. In some of our large buildings any depreciation of pressure on the hydraulic elevator tanks is replaced by means of compressed air.

In fact, there seems to be no limit to the employment of this power, and inventions in the success of which it is an important factor, and new methods of performing old tasks which it renders possible, are continually being introduced. And with the recent improvements in the direction of increasing the economy and efficiency of the prominent types of air-compressing machinery, and the further advantages realized from developing increased power by reheating the air, many foresee the era when a central plant will be established and a compressed air main will be situated under every street, operating mills and factories as in Paris and Birmingham ; ventilating buildings in summer and warming them in winter; preserving perishable merchandize in cold storage; operating elevators, grinders, pumps, saws, printing presses, lathes and the countless other machinery of commerce. Others even go further and look for its introduction into houses, the same as gas and water, for ventilating, for warming in winter and cooling in summer, and for operating lifts, sewing and washing machines, and even clocks.

In compressed air we have a power ever ready to do our bidding, summoned or dismissed by the simple turning of a valve. It operates in place of steam without the least change of plant, obviating the employment of engineers and firemen, doing away with boilers and their accompanying disadvantages of waste steam, smoke, ashes, dirt, dust, risk of explosion, disagreeable odors, the expense of cartage, increased rates of fire insurance, water tax, etc. The old maxim, that "importance oft attaches to trifles light as air," becomes doubly true when we consider that this atmosphere, always so necessary to human existence, is being concentrated and harnessed to the service of mankind in so many new and widely different ways.

Notes on Water Power Equipment.

Mr. A. W. Hunking, in a paper read before the Boston Society of Civil Engineers, remarks that in comparing different makes of water wheels by means of reliable tests, it is found that their efficiency under favorable circumstances ranges generally from 80 to 85 per cent., and any wheel above the 80 per cent. grade may be considered good. Accordingly 80 per cent. useful effect is assumed as a basis for comparison in the paper, and it is also assumed that water is furnished to the consumer in the manner practiced at Lowell, Lawrence and Holyoke, where measurements are made daily of the amount used ; also a unit of 600-horse power is taken and a fall of 13 feet with the wheels generally running at full capacity. This amount of power would require 509 cubic feet per second with 80 per cent. efficiency, and 582 cubic feet with 70 per cent. The difference between these two volumes, 73 cubic feet, is capable in itself of developing on an 80 per cent. wheel with a fall of 13 feet about 85½-horse power. In undertaking to establish a commercial value for this 85½-horse power, we may trench on debatable ground owing to the different lights in which an engineer may see fit to establish values.

At Lowell, Mass., where Mr. Hunking was for several years connected with the corporation managing the water power of the Merrimac River, the years 1888-90 were remarkable for the amount of rainfall. The "flood-water" stage prevailed in the river for 72 per cent. of the whole period, and the "ordinary-water" stage nearly all of the balance. To base the value on these conditions would reduce the average annual cost of water power at Lowell to a minimum, assuming the rates to be always as at that time—viz., $4 per mill power per day during "ordinary water," and $2 during "flood water," the mill power being equivalent to 85 gross horse power. The average annual cost per horse power on the above basis was for the period indicated $11.64 on the shaft, assuming 80 per cent. efficiency. If a 70 per cent. wheel were chosen, the 85½-horse power required in addition to that for an 80 per cent. wheel would cost $995.22, which is the interest at 6 per cent. of $16,500. When it is recalled that the entire cost of an equipment with 80 per cent. wheels should not exceed $15,000, exclusive of masonry, and long feeders adapted alike to either equipment, it will be seen that the difference in cost between wheels with the highest and lowest efficiency could have been easily afforded.

Another view of the matter is to be taken in the case of many streams which furnish sufficient water to owners of the power rights to supply low efficiency wheels many months in the year, and probably have a large waste in addition. Under these conditions the loss due to low efficiency can be charged against the wheel only during the part of the year when the stream fails to meet the demands of the wheel and the deficiency in power is made up by steam. Assuming this deficiency to occur for three months in the year, then the loss averages about 21-horse power throughout the year. If the value of power is estimated at $10 per horse power on the shaft, the loss is equal to $210, which is the interest at 6 per cent. on $3,500. Again, if the power is assumed to be worth only $5 per horse power, the capitalized loss will be about $1,750, which is more than 10 per cent. of the first cost of the high efficiency equipment at $25 per horse power. Such cases as the foregoing are probably infrequent, but they outline to some extent the consideration of which the matter of efficiency is worthy.

Peculiarity of construction, durability and strength of parts, are other factors which must be judged from such information as can be obtained. Most of the wheels in the market to day are made largely, if not entirely, of cast iron, and when suitably designed to withstand the heads under which they are to operate, will prove very durable, judging as well as possible from past experience. The only protection which the engineer has against imposition is to provide in his contract for a trial before acceptance, either *in situ* or in some such place as the Holyoke testing flume. If conducted at the latter place, Mr. Hunking states that the cost is not excessive and the test is equivalent to one *in situ* so long as the conditions of head and setting are similar in both cases. In connection with the matter of construction as effecting efficiency, attention is called to a pair of wheels with heavy cast iron buckets noticed in Minneapolis. On the convex or back side of every bucket in the wheel a place as large as a man's hand had been eroded, slightly at the outer limits and growing deeper toward the center. The cavities were at the same part of each bucket, and a hole about an inch in diameter had been worn completely through the metal in each case. This erosion is attributed to internal eddies in the wheel, which caused a perpetual drilling on account of the grit in suspension in Mississippi river water.

The next point worthy of note is the use of large openings in the more modern wheels, a practice brought about by John McCormick and exemplified in the design of his "Improved Hercules" wheel and its prototypes, for which he is undoubtedly entitled to the everlasting gratitude of the water power community. By the use of fewer buckets and guides, comparing wheels of the same diameter, he has materially increased the size of the openings so that many of the floating obstructions abounding in the average river are allowed to pass through the wheel without injury to it, and without clogging its channels, as was too often the case with wheels of smaller openings. Many instances could be cited where the older style of wheels have become entirely stalled from an accumulation of leaves, sticks and other debris in the stream, entering the wheel and choking its channels until the wheel refused to turn. This difference in the size of openings will be appreciated when it is stated that the openings in a 100 inch Boydon wheel at the Tremont mill, the test of which is given in the late James B. Francis's "Hydraulic Experiments," were 44 in number and measured about 7 inches in width by 11 inches in height. A 72-inch Swain wheel of somewhat greater capacity has 25 openings, each 8¼ x 14 inches, and a 48-inch McCormick wheel of about the same capacity has 19 openings measuring 8¼ x 19 inches, and in spite of this great increase in the size of openings, its efficiency is up to a high mark. It should not be understood that the above figures indicate the least cross-section of the water passages of the wheels; they simply indicate in a general way, and with sufficiently close approximation, the difference in the types of wheels.

Much has been written by various authors on the subject of low-speed and large-diameter wheels compared with high-speed and small-diameter wheels. In considering this subject it must be borne in mind that this matter of speed is relative merely ; a wheel develops different speeds under different heads, since the outer circumference must be run

at about 70 per cent. of the velocity due to the head to obtain its highest efficiency.

In the adoption of a wheel the engineer must have in mind the delivery of the power developed, and it frequently happens that the manner in which this delivery is limited has a controlling influence in the selection of the wheel. As a rule, all old mills were speeded to run very slow, but the present great competition in all lines of business makes it imperative for the manufacturer to run his machines at increased speed. Here is an opportunity for the class of fast-running wheels under the head available, and the wheel giving the desired speed with properly proportioned belts or gears and the necessary power at the same time, is the wheel to be selected.

Electric machinery as constructed up to the present time by most manufacturers, has called for fast-running wheels under all moderate heads, in order to furnish anywhere near the speed demanded, and it requires more than an ordinary fall to supply the speed to drive this class of machinery without having to resort to countershaft driving. Except in mountainous districts which furnish water power peculiar to itself, falls are but rarely found which give too high a velocity. When this is the case, however, the difficulty can generally be overcome by a special pattern of wheel, derived from one of sufficient diameter to give a suitable speed with the available head, by cutting down its depth and thus reducing its capacity. It is evident that on a moderate fall a reasonably high initial velocity is desirable in the wheel to save as much as possible in the size of the gears, when the power is taken off by this means.

Combination Heating.

By Mr. George Hoffman.

The word "combination" may be defined as the result of combining or joining together two or more different elements or systems into one harmonious whole. There are several distinct and different systems of heating, and the combining of any two of these systems into one would naturally result in a combination system. The specific form of combination heating which I wish to treat of is obtained by a combination of steam or hot water and air, or, as it is commonly called, furnace heat. The advantages of the combination system in buildings suitable to its use are manifold, but in order that these advantages may be made apparent it may be necessary to diverge a little. Heat is supposed by many to be an actual and discernible substance, and until within a very few years even the more advanced students of natural physics were of the same opinion. Later investigation has shown that heat is nothing more or less than molecular motion, consisting in case of air of nearly uniform rectilinear motions, with sudden changes in direction and velocity when the molecules come too near one another; in case of a liquid of irregular wandering of its molecules, and in case of a solid of orbital or oscillatory motions. By the foregoing definitions it will be readily seen that air will absorb heat much more rapidly than either liquids or solids, and as in combination heating we are depending for fully 50 per cent. of our heat on air heat, the natural conclusion is that a combination heater will give results in the rooms to be heated much quicker than either straight steam or straight hot water.

Heat is communicated from one body to another in three ways, viz.: Radiation, convection and conduction. Radiant heat passes from one body to another at a distance through the air in straight lines and with great velocity, but it does not, to any appreciable extent, warm the air through which it passes. Conducted heat passes from one particle of matter to another at insensible distances, as an iron bar with one end in the fire becomes gradually heated at the other end. Convected heat is the movement of the heated body itself from one point to another, as the circulation of hot air or hot water. In combination heating we again have an advantage over straight steam or hot water, as we utilize in the rooms to be heated two or three processes of heat distribution—*i. e.*, radiant and convected heat—while in steam or hot water only the radiant heat is utilized.

One of the most important features of combination heating is the fact that where the air supply is taken from the outside, as it always should be, it insures a perfect ventilation throughout the building, as well as heat. The necessity for ventilation is very little appreciated by the general public, but as heating and ventilation have always seemed to me to be inseparable, and as the people naturally turn to our profession for their knowledge of these matters, it might be well for me to ask, What is ventilation and why is it necessary? Ventilation is the act of replacing foul, impure air, in a confined space, with pure air. Please note that word "replacing." Times without number have I had people assure me that they had looked out for the ventilation of their houses, as they had fireplaces in all the principal rooms. When asked if they did not know that "Nature abhorred a vacuum," and that their fireplaces would not exhaust unless there was some means provided for replacing the air thus removed, would reply, "They had not thought about that, but guessed there would be enough leaks in the doors and windows anyway." I could cite any number of leading authorities and read whole chapters showing the necessities of ventilation and the vast consequences of the result of continued breathing of impure air, but a mere statement of the component elements of air will suffice for this article. If we divide air into 10,000 parts its composition would be as follows: Oxygen 2,096, nitrogen 7,900, and carbonic acid 4 parts. When the proportion of carbonic acid in a room is increased from the normal amount of 4 parts in 10,000 to between 5 and 7 in 10,000, a faint, unpleasant odor is usually perceptible to one entering from the fresh air; if the proportion reaches 8 per cent. the room is said to be close. According to some authorities a full-grown man at rest will exhale through the pores of the skin and from his lungs nearly ¾ cubic foot of carbonic acid per hour. Taking a room containing 2,500 cubic feet of air in its normal condition, we find that the air contains 1 cubic foot of carbonic acid. Now, let us suppose this room to be a sleeping room, not ventilated, occupied by two persons eight hours each night. If the windows and doors of the room were closed during the eight hours the natural portion of carbonic acid would be increased to about 13 cubic feet (or 1 part to 200), and the occupants would rise in the morning with depressing headache. A person coming into the room from the outside would declare the air to be "foul," and a man does not need to be a crank on ventilation to reach the conclusion that such a situation would be anything but healthful. This condition could be obviated, to a certain extent, by raising the windows, but that practice is dangerous in results, is a prolific source of colds and sickness, and as a means of ventilation totally unreliable, not to mention the morning's discomfort of arising in a cold room. Accurate ventilation will replace the air in a given room every 20 or 30 minutes without draft.

I wish to call attention here to the reason why the combination heater will from natural causes give more perfect and greater results in ventilation than it is possible to obtain from indirect steam or hot water, more particularly hot water. The force which we use to crowd the fresh air into the room and drive the foul air out is due to the expansion of the fresh air by heat. Air expands $\frac{1}{491}$ of its bulk for every degree it is heated above 32° F.

Thus it will be seen if we heat the air 55° warmer than the surrounding air we have increased its bulk nearly one-tenth. The greater the difference in temperature the greater the expansion, and, as a natural consequence, the more rapid the movement of the warmer air. On a moderate winter day the indirect radiator in a hot water job is rarely heated over 130° to 140° F., and as it is not possible for the air in passing through the stack to absorb more than from one-half to two-thirds of the heat, the temperature of the air flowing into the room under such conditions will rarely exceed 75° to 80° F. As the force with which the air comes into the room depends upon the difference in temperature of the air in the stack and the air in the room, it will be readily seen that the movement must be very sluggish. With the combination heater, the air coming in contact with the fire and smoke surfaces only, the temperature is raised much higher, with the result of a rapid flow of a large volume of air into the room in question.

Now one more point, then I am through. In installing a combination job great care should be taken to place the heater as near the center of of the work as possible, locating all air registers as near the heater as practicable, so as to insure short connecting pipes in the basement. Always locate registers away from windows or cold walls, selecting, if possible, the warmest side of the room. Cold and warm air are always antagonistic, and you should give the warm air all the advantage possible if you wish for the best results.

Lastly, the combination system of air and water heating particularly is in the market to stay, and to you who are interested in residence or school heating the subject is worthy of your most careful consideration.

Progress of Smoke Abatement in St. Louis.

At a meeting of the Engineers' Club, of St. Louis, Prof. W. B. Potter read a paper, the title of which is given in the heading. In the course of his remarks he said that two inspectors had been appointed, who had been busy on preliminary work for the past two months, and that prosecutions were now about to be started against offenders, for which purpose a special attorney had been secured by the Citizens' Executive Committee. A month's notice was served on offenders after having been

reported by the inspectors, after which time they are to be prosecuted if they do not abate their smoke. The paper also stated that the Smoke Prevention Committee, of which Professor Potter was Chairman, was not prepared to make a final report, as only three devices had been thoroughly tested—the Hawley down-draft, the Boileau, and the zig zag grate bar.

About 50 different devices for preventing smoke are in use in St. Louis, some of which were quite extensively and successfully used. Difficulty was found in getting accommodations for testing new devices, but five more are to be tested next month. The steam jet principle is used in many of the devices, the down-draft in several others, and coking arches in others. So-called combustion powders or compounds, to add to coal before or during use, are being advocated. These usually consisted of about 25 per cent. of niter, with salt, sulphate, or carbonate of soda, carbonate of ammonia, etc., which were supposed to improve the combustion, prevent smoke, and slag the ashes; the paper states that they are valueless, as the amount of niter was too small to do any good, as only 3 pounds of powder is used, while the trouble with our ashes is that they are too fusible already, and hence clinker on the grate bars.

The assertion was made that the work of the Committee had resulted in creating a demand for better designed boilers and greater care in operating, besides abating the smoke; that more care was being exercised in selecting fuels, and that probably coal would soon be sold on the basis of heat units capacity in this market. The steam jet principle is usually quite effective in preventing smoke, but generally at a slightly increased consumption of fuel. The paper cited a case, however, where an economy of 18 per cent. had been attained with a steam jet where a bed of 15 inches was carried on a hard-worked boiler, though when the thickness was increased to 20 or lessened to 8 inches there was a loss in economy and capacity. The down-draft type was not only effective in preventing smoke, but increased the efficiency and economy of the plant, and 40 to 45 pounds of coal per square foot of grate surface, with a good draft, or 50 pounds with a strong draft, could be burned on down-draft grate bars.

The Wabash railroad was said to be preventing smoke on its locomotives by a combination of a steam jet and a baffle arch, which latter did away with the excessive noise of the jet. A new down-draft device had been brought out in London, England, for domestic stoves and ranges, that was quite successful and which promised to solve the smoke problem from dwellings, but smokeless fuels, like coke, anthracite, oil, and gas, are already available, which not only prevented smoke, but are much cleaner, and crushed coke is but little more expensive than coal.

The paper was discussed by Messrs. Brunner, Colby, Professor Johnson, Bryan, Moore, Professor Wheeler and Professor Kinealy. Mr. Bryan stated that the extra expense of adding a down-draft device to a 100-horse power plant was about $800, while Mr. Moore added that an economy of about 23 per cent. in fuel would thereby be saved. Prof. Potter stated that no ordinary grate bars would satisfactorily prevent smoke, over long periods, where the care of the fireman had to be depended on, no matter how slow the rate of combustion.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Standard Gas and Electric Light Company, of Huntington, L. I., it is said, have at last reached the point where they announce their ability to supply gas for lighting and fuel purposes to the residents on the lines of the Company's mains. It is high time that this was done.

MANAGER THOMAS, of the Vancouver (B. C.) gas works, rejoices in the possession of a new set of purifying boxes, 16 feet square by 4 feet in depth. The body of the boxes is in cast iron, the covers being of wrought iron. The prepayment meter has also been introduced in Vancouver, where it has met with some favor. The instrument used is that made by Messrs. W. & B. Cowan, of London and Edinburgh, and it is adjusted for operation on a basis of coin equal to the U. S. 25 cent piece.

THE Reading (Pa.) Traction Company has placed the order for its new car house with the Berlin Iron Bridge Company, of East Berlin, Conn. The side walls are to be of brick, and the roof is to be of iron, and the dimensions of the structure are 180 feet in length by 85 feet in width. The width is divided into two parts of 42½ feet each, a row of columns supporting trusses at the center.

THE Philadelphia *Telegraph* says that on the 6th inst. the Committee of Councils on Municipal Government agreed to favorably recommend an ordinance to advertise for proposals for the erection of a plant at Point Breeze for the manufacture of water gas; the price at which it is to be furnished to the city holders to be open to competition; the contractors to furnish $50,000 bonds for carrying out the terms of their proposals. The ordinance was drawn in pursuance of a proposition from the National Steam Heat and Power Company, of which Colonel John I. Rogers is President, to erect a plant and furnish water gas to the city holders of an illuminating power of 22 candles at 25 cents per 1,000 cubic feet. The offer of the Company is to be given a 30 day test. There was a lengthy discussion in the Committee, but the ordinance was finally acted upon favorably.

MR. C. S. PUTNAM, formerly engineer of the Petaluma (Cal.) Electric Light Company, has accepted the position of Superintendent of the electric light plant at Hayward, Cal.

THE water power that drives the dynamos that Portland (Oregon) depends upon for its street lighting is at such a high stage that the handsomest city in the Webfooted State has found itself in darkness more than once during the present rainy season. Anent this uneven state of affairs the *Oregonian* recently had the following to say: "For several nights Portland has had no street lights, which is due to high water at Oregon City. The experience proves that we do not really need any, and that the city may save $80,000 a year. After this experience it will be absurd to pretend that we need to expend any such sum for lights. We can do just as well without."

THE authorities of Cohoes, N. Y., have awarded the contract for the public lighting to the Cohoes Gas and Electric Light Company, the Company agreeing to maintain any desired number of 2,000-candle power arcs, on the basis of a payment of $108 per arc per annum. The agreement is to last for five years.

ON January 1st, 1894, the price of gas supplied by the Malden and Melrose (Mass.) Gas Light Company is to rule at $1.90 per 1,000 cubic feet, gross, payment of accounts within 20 days from their presentation to entitle the consumer to a rebate of 30 cents per 1,000.

THE Lynn (Mass.) Gas and Electric Light Company has moved its electric light plant from the old works on Pleasant street to the handsome new station recently constructed on the site of the gas works.

A CORRESPONDENT at Atlanta, Ga., writing to us under date of December 3d, says: "At a special term of the Superior Court the Gas Light Company, of Augusta, Ga., through its attorney, Leonard Phinizy, obtained an order from Judge H. C. Roney granting that Company amendments to its charter, allowing the Company to conduct in the future a coal, wood, oil and stove business. The Gas Company has arranged with Mr. George S. Hookey for the purchase of his coal business, the new purchaser to take control on the 16th inst. As you know, Mr. Hookey has resigned the Superintendency of the Augusta Company, and his successor will be Mr. T. W. Summers, formerly under Mr. Baxter, at the Detroit works, and later, I think, in charge of the Penn Yan (N.Y.) gas plant. Mr. Summers takes active charge at Augusta on January 1st. President Barnes is now North, in company with Mr. Summers, considering and investigating certain additions and improvements to be made to the gas plant. It is also said that the Company proposes to start an electric lighting plant here, to enable it to bid for the lighting of the streets of the city."

DESPITE the fact that the public electric lighting of Lawrence, Mass., which has been carried on for several years by the Lawrence Gas Company, was always maintained at prices which seemed to outsiders to be ridiculously low, the local authorities were in the not long ago seriously considering the advisability of engaging in the business on municipal account. In fact, a more or less extended investigation of the experience of other municipalities in this direction was made, which, however, luckily for the ultimate benefit of the taxpayer, failed to convince the rulers of Lawrence that it would be a good thing for them to try it on. Even the contractors admitted that Lawrence was not as well lighted as it should be, but they had nothing to choose from in respect of bettering the condition of things, since the City Fathers not only specified the number and type of electric lights that were to be used, but also designated the points where the lights should be placed. This fall, however, the Gas Company was asked to bid on a new contract, which called for a greater number of lamps, and after some debate the new agreement was signed about November 1st. Since the date of signing the Company has been busily engaged in putting the new lamps in circuit and

in making some re-arrangement of those already in use, and it was not until the 9th inst. that all of the new arcs were started up. It so happened that the initiation of the improved lighting was made when the ground was covered with a mantle of snow, and the general effect was excellent indeed. The new lights consist of 15 full arcs and 45 divided arcs. As the arcs (85) formerly in use were placed on the chief corners in the center of the city, the new ones have been located between these, to fill out dark places, and also on the most frequented thoroughfares in the residential portions of the city. Hitherto these portions have been lighted exclusively by incandescent electric lights, so on the evening in question, as will be the case in future, people taking the frequented thoroughfares on their way home, had the advantage of some well-lighted corners, at least, and everyone seemed very much pleased. Lawrence is peculiarly situated in one respect. The city is in a valley surrounded by three hills, which are pretty well covered with houses. Up each of these hills only one or two main streets run, so that Mr. Humphreys, in laying out the lights, took good care of these avenues, to the delight of the residents of those sections. Another scheme which has been kept in mind was to light the streets which lead to the adjoining boroughs of Methuen and North Andover, both of which towns are lighted by the Lawrence Gas Company; and Mr. Humphreys has been working of recent years in the direction of having them light the streets leading to Lawrence, wherefore the matter has been pretty well completed by having Lawrence light its thoroughfares in these directions. The terms of the new contract cover about 530 incandescents, 100 full arcs and 45 divided arcs, the rates being $100 for full arcs and $90 for divided arcs, on an all night table. These rates are low, but, as before intimated, Lawrence always has had low prices on arcs. Back in 1882, before the Gas Company had control of the business, the city was paying only $10 a month for arcs, burning till 12 o'clock, when other cities were paying twice that price. The figure was then forced down to $100 a year, and then the Company was asked to extend the lighting to 12:30, and later, to light up mornings when the mill hands were going to work, the price remaining the same. This season, as noted in the opening sentences, the city started a committee to investigate municipal lighting, and as many of the figures of cost of electric municipal plants indicate very low prices, it was hard to combat this aspect of the case; for although those familiar with the business know many of these figures are unreliable, it is difficult to convince a city government of that fact, when the figures come to hand over the signatures of the city officials. Moreover, there was some dissatisfaction at the street lighting, owing to the small number of arcs and the larger number of incandescents, which had been put in in previous years against the advice of Mr. Humphreys. It was, therefore, claimed that they could put in their own plant and get more light for less or the same money. It was this aspect of the case which led the Company to make the all-night proposition, and the placing of the new lights was left at the discretion of Mr. Humphreys. Saturday night week saw the completion of this contract, as already noted, and now the city has 100 full arcs and 45 divided arcs. In 1887, when Mr. Humphreys took charge of the arc light business in the city, there were only 20 arcs used by the city; now there are nearly 150. The total capacity of the arc plant at that time was about 80 lights; now it has increased to nearly 500. This bit of history also goes to show that the junior Vice-President of the American Association has lost none of the sure-going, systematic methods that marked his earlier management of the Lawrence Company. In fact, we might remark that he has brought them to fuller fruition.

IT is Colonel Frank S. Richardson now, if you please, by virtue of his appointment to such position on the staff of the recently elected Governor of Massachusets. Nor can Colonel Richardson be said to be other than a veteran in the military circles of the State, for he served with distinction in the 2d Regiment of Massachusetts as Captain of Company F in that crack State corps. We tell you, they cannot get along without the gas men in any walk of life. We salute you, Colonel!

BOGUS gas meter inspectors are cropping out again, the police officials of several cities in as many States having been notified of depredations committed by thieves who masquerade as inspectors of gas meters and the like.

THE electric light plant at Taylor, Texas, was recently sold under foreclosure proceedings, at the instance of the Taylor National Bank, which had a claim against the property amounting to $7,000. The price paid was $8,500, and the purchaser was Hugh Burns, who it is said acted on behalf of the residents of Taylor, who propose to reorganize the concern and keep up the business under new management.

DURING the month of November the following dividends on gas shares were paid in San Francisco:

	Rate. Per Share.	Amount.
Central Gas Company	$1.00	$20,000
Oakland Gas Company	.20	6,000
Pacific Gas Improvement Company	.50	15,000
San Francisco Gas Light Company	.35	35,000

Of these the dividends by the Central Company represents a quarterly disbursement, the others being for the month of November alone.

SOMETHING over a week ago a deed of warranty was filed in New Haven, Conn., transferring to the New Haven Gas Light Company all the property and possessions of the Fair Haven Gas Light Company. This proceeding was merely formal, in that the Fair Haven works have been actually under the domination of the New Haven Company for some time. The Fair Haven plant is located on Mill street at the intersection of Saltonstall avenue.

TACOMA, Washington, owns and operates on municipal account an electric lighting plant, and the men who are paid to operate it have an organization which they term the Sunflower Club. Some time ago the "Sunflowers" gave a ball, and the dancers glided and hopped underneath the dazzling rays of several arc lights, which had been put in place without any authorization of the city; nor did the "Sunflowers" pay anything to the city for the illumination mentioned. Meanwhile Tacoma taxpayers are asking themselves if such acts are "regular."

MR. C. F. FOLLMER, Secretary of the Milton (Pa.) Gas Company, is greatly pleased over the results which have followed the inauguration in that bustling town of the dollar gas rate, net, for all gas used for fuel and power purposes. The gross charge is $1.25 per 1,000, and a discount of 20 per cent. is allowed on all bills settled by the 15th of the month. Mr. Follmer says that gas is supplied to several engines and a number of gas stoves with very satisfactory results to customers and Company. The general rates for illuminating purposes are as follows: the gross being $2 per 1,000:

Monthly Consumption.	Discount. Per Cent.	Net Rate.
200 cubic feet or under	—	$0.50
300 to 6,000 cubic feet	15	1.70
6,000 to 12,000 "	17½	1.65
12,000 to 20,000 "	20	1.60
20,000 cubic feet and upward	25	1,50

THE pryprietors of the Altoona (Pa.) Gas Company last month donated 1,000 bushels of coke to the Quick Charity fund of that city, and also agreed to deliver the same free to the worthy poor, on orders from the Superintendent of the Quick Charity. This generosity resulted in the relieving of so much distress that the Company ordered that a similar donation be made in the current month.

COL. THOMAS AXWORTHY, formerly well known in gas coal shipping circles from his connection with the New York and Cleveland Gas Coal Company, died at Hamilton, Ontario, on the afternoon of the 6th inst.

THE Fall River (Mass.) Gas Works Company is now comfortably installed in its handsome new business offices, No. 9 Bedford street. Manager Brown and Superintendent Nute have managed to get together a very complete assortment of gas cooking and heating appliances, and the same are well displayed in the Company's office quarters.

"OBSERVER" forwards the following under date of December 6th: "The Committee on Street Lights of the Newton (Mass.) Council, to whom had been referred the order to investigate and report upon the feasibility and advisability of establishing a municipal gas and electric lighting plant in Newton, have made a report recommending that the City Council take immediate action whereby the city may avail itself of all the privileges contained in the act of the Legislature of 1891, entitled an act enabling towns and cities to establish and maintain plants for the manufacture and distribution of gas and electricity. The report was accepted, and its acceptance was followed by the presentation of an order by Alderman Roffe, directing that the City Council determine to adjudicate and to exercise the authority conferred by Chapter 370, Acts of 1891, entitled an act enabling cities and towns to establish and maintain plants for the manufacture and distribution of gas and electricity. Mayor Fenno inquired as to the significance of the above order, and Ald. Roffe replied that it committed the city to an exercise of its rights and privileges under that act, a course that would enable the next City

Council to refer the subject to the people at large at the next municipal election for ratification. The order was then unanimously adopted."

"OBSERVER" sends the following, respecting the progress of the Waltham (Mass.) Gas Light Company, taken from a local paper: "The artificial lighting of streets, stores and dwellings from a commcn or central station, under the then new method of gas manufacture and distribution, dates from the year 1853. During the early part of that year several public-spirited men petitioned the Legislature for a charter, which being granted, the Waltham Gas Light Company became a body corporate April 1, 1853, with a capital stock of $35,000. The first Board of Directors comprised Dr. Horatio Adams and Messrs. R. P. Davis, I. R. Scott, R. S. Warren and H. Moore; Mr. Thomas Page was Clerk and Treasurer. A lot of land comprising about 5 acres was purchased near the river, on what is known as the South Side, and the Company began business. The first holder erected had a capacity of 30,000 cubic feet, and so great was the demand for the new method of lighting that a second soon followed. For a few years these two supplied the demand, but the steady growth of the town caused a third holder to be erected, which was followed about 13 years ago by the fourth and last, the total capacity of all being about 350,000 cubic feet. The gas plant as it stands to-day comprises the generating building, holding 8 benches of 6 retorts, with a total capacity of 400,000 cubic feet per diem, with well equipped buildings holding the exhausting, condensing, scrubbing and purifying apparatus, station meter, steam equipment, storage houses, and so on. The whole shows up a well arranged plant, easily accessible from either the railroad or street, and located on one of the prettiest plots of land in Eastern Massachusetts. The fact that landscape gardening has been a feature ever since the organization of the Company is what makes the surroundings so attractive to the passer-by. When the innovation of electric lighting came along, Waltham was not slow to get into line. The subject was first broached in Waltham early in 1886, but before a decision was arrived at considerable controversy ensued. While the Gas Company stood ready to take hold of the project and push it to a successful issue, there were others who thought they could see a dollar in the venture, and a new Company was organized. The feeling, however, seemed to be that the Gas Company could furnish cheaper lighting, from the fact that it had a waste product of coke from its retort house with which to generate power for the dynamo engines; that it had other material which a new company would of necessity be obliged to purchase, together with the fact of the availability of the plant itself. The result was that during the summer of 1886 a committee appointed from the new Company met and conferred with the Directors of the Gas Company, the result being a transfer of all rights from the former to the latter. The Company having the franchise began work at once under the name of the Waltham Gas and Electric Company, and immediately began the erection of a new building. The structure was 48 feet by 70 feet, of brick, and two stories in height. Two Armington & Sims 60-horse power engines, two 50 arc light and one 650-light incandescent T. & H. dynamos were purchased, and so rapidly was the work rushed that on Christmas-eve, 1886, the first current of electricity was turned on, 19 street lights being connected at the time. Power was furnished from a 160-horse power boiler, located in the gas manufacturing building. The demand for the lights was such that only a few weeks elapsed when 25 commercial arc lights were added. With continual additions to the dynamos already in use they soon became overloaded, a 56-horse power straight line engine was put in, together with a third arc dynamo and a 1,500 in candescent alternating machine. With the machinery and dynamos then in use the building was somewhat crowded. To increase the plant a new building was needed, and in 1889 its erection began, being a duplicate of the first. In the west end of the new structure was built an engine room, 45 by 38 feet, and three upright Manning boilers, of 150-horse power each, placed therein. In the adjoining portion of building was placed a 300-horse power compound condensing engine. The Newton street railway having put in an electric circuit for its cars, the Waltham Company contracted to furnish power, the result being the purchasing of two 80-horse power generators. For a year business was conducted with this plant, but the normal growth of the city, the additional power required for street railway service, and a demand for power for local manufactories caused another increase. Two more 80-horse power generators were purchased, which covered all demands for the time, and a 60-arc light dynamo added. Eighteen months later an annex was built adjoining the power house, to which was transferred the original plant of three engines and three dynamos. The again crowded building rendered this step necessary, and to economize space a second 300-horse power engine supplanted the three removed. Last year, in the summer, two additional upright 150-horse power boilers were erected in the boiler room, with a foundation for a third when it should be required. At present there are about 160 arc street and about the same number of commercial lights in use, with dynamos equal to a capacity of 300 more; the incandescent dynamos are equal to the supply of 5,000 lamps. The present Board of Managers is: President, Lowell Clark; Treasurer, Manager and Clerk, George A. Stearns; Directors, A. M. Goodale, John R. Farnum, William Roberts, A. T. Lynam and Augustus Flagg. Col. C. F. Spaulding is General Superintendent and F. T. G. Hill is the Electrician, both gentlemen having been with the Company for several years."

MR. F. M. NICHOLS, Mayor of Wilkes-Barre, Pa., has recommended to the City Council the passage of the following ordinance:

Section 1. That all gas companies doing business in this city are hereby required to immediately stop any leakage of gas from their mains or other pipes at any point where the same is injurious to the health or comfort of the people, under a penalty of not less than $5 or more than $25 for each and every day the said leakage is permitted or suffered to exist after notice thereof is given to the company blamable therefor.

Section 2. Whenever any leakage, such as that named in the first section of this ordinance, shall exist in any neighborhood occupied with the pipes of more than one gas company, and on account thereof the company responsible for the same cannot be ascertained without investigation, in case any or all of the said companies refuse or neglect to forthwith make such investigation after receiving notice of said leakage, it shall be the duty of the City Engineer to cause the same to be done, and for that purpose he is hereby authorized to expose the pipes of said companies, employ experts and incur any and all other expenses necessary to a discovery of the cause of said leakage, and the company owning the pipes from which it is thus ascertained the said leakage issues, shall immediately reimburse the city for the moneys used in payment of the aforesaid expenses, and make such repairs of their pipes as is necessary to stop the said leakage in the manner provided in Section 1, and in default of compliance with this latter requirement, be liable to the fine imposed in said section.

IT is said the demand for gas at Morristown, N. J., is so great that the new plant constructed there some two years ago is unequal to the supply thereof.

THE contract for the placing of machinery and the laying of mains for the West Side Gas Company, which proposes to supply gas to the residents of Edwardsville, Kingston and other boroughs close to Wilkes-Barre, Pa., has been awarded to Mr. A. J. Roat. We understand that the generating apparatus is to be of the improved Merrifield-Pearson-Westcott type, and that it will be erected by the Economical Gas Apparatus Construction Company, of Toronto, which controls the patents for the process named. Under the ordinance granted the West Side Company the latter agrees to be in position to supply gas to the residents by May 1, 1894.

THE ordinance authorizing the city of Philadelphia to purchase the plant of the Philadelphia Gas Improvement Company has been adversely reported.

THE storage plant which the Baltimore Consolidated Gas Company is constructing in the Catonsville district is being rapidly pushed.

THERE is a chance that the gas plant at Eastport, Maine, will be overhauled instead of being dismantled, the proprietors having reconsidered the conclusion to "go out of the gas business for good."

A GAS well of fairly good volume was drilled at Grand Junction, Colorado, some weeks ago.

Transportation of Liquid Air.

In connection with the forthcoming lecture at the Royal Institution on "Air, Gaseous and Liquid," it may be mentioned that Prof. Dewar has successfully conveyed a considerable quantity of liquid air from London to Cambridge. The liquid air was carried in one of the double glass vacuum jacketed flasks, the space between the inner and the outer flask containing nothing but extremely attenuated mercurial vapor, together with a little liquid mercury. On pouring liquid air into the inner flask its outer surface is rapidly covered with a mercurial film of extreme thinness, forming a reflecting surface highly impervious to radiant heat. As soon as this is formed the whole apparatus is packed in solid carbonic acid, which at once freezes the liquid mercury, arrests the deposit upon the mirror, reduces the mercurial vapor to an infinitesimal quantity, forms an almost perfect vacuum, and supplies an envelope 80° below zero. Thus protected, the liquid air reached Cambridge. The protective power of the high vacuum and the mercurial mirror will be better appreciated if it be borne in mind that the difference of temperature between liquid air and solid carbonic acid is the same as between ice and boiling water.

The Market for Gas Securities.

The feature in the trading in city gas shares for the week was a sharp decline in the shares of the Consolidated Company, which on somewhat large offerings sold down to 125¾. Yesterday 800 shares were dealt in on the Exchange, at 126¼ to 125¾. At the close the highest figures for the day were reported, the quotations being 126¼ bid, offered at 127; but no sales were made at a higher figure than 126¼. Various causes were assigned for the slump, some asserting that quite a large block hitherto held for investment account was put on the market, and others held that the unusually large offerings were chargeable to the belief of the holders that the incoming Legislature will order a reduction in the gas rate to $1. The physical condition of the Company is first-class, and the business outlook is very favorable. We would strongly advise the purchase of the shares at the current price. The opening today (Friday) was 126 to 126¼. Some sales of Standard preferred were recently made at 77, and 75 is freely bid. The regular quarterly dividend of 1 per cent. on the preferred stock was declared on the 13th inst., and is payable on January 2d. Other city shares show no marked change. Brooklyn shares are strong and higher, notably Williamsburgh and old Brooklyn, for which latter 115 is bid. Several judgments were recently entered against the Equity Company, about which concern there soon ought to be something reported in the nature of legal proceedings. Baltimore Consolidated is in better favor at 54½ to 55, Chicago gas is stronger, at 68 to 68¼, and Bay State is weaker, at 15 to 15½.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

December 18.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	126	126¼
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	190	195
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	145	150
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	50	65
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	—	32
Preferred	5,000,000	100	—	77
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	115	120
Citizens	1,200,000	20	55	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	25	40
Fulton Municipal	3,000,000	100	130	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	75	80
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	145	150
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	145	—
" Ctfs.	700,000	1000	99	100
Williamsburgh	1,000,000	50	145	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	15	15½
Income Bonds	2,000,000	1000	40	—
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	77	79
2d " " "	3,000,000	1000	—	57½
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company	25,000,000	100	68	68¼
Chicago Gas Light & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	—	30
Bonds	600,000	1000	—	85
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt	11,000,000	100	54½	55
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.— 1st Mortgage			45	—
East River Gas Co., Long Island City	1,000,000	100	—	—
Bonds	500,000	100	86	87
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200

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Schleicher, Schumm & Co., Phila., Pa..... 864

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American Meter Co., New York and Philadelphia..... 883
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DIVIDEND NOTICE.

STANDARD GAS LIGHT CO. OF THE CITY OF NEW YORK, 71 BROADWAY, NEW YORK, Dec. 13, 1893.

The Board of Directors have this day declared a dividend of one (1) per cent. on the Preferred Stock of this Company, payable on Jan. 2d, 1894, to stockholders of record at 3 o'clock P.M., Dec. 20th, 1893.

Transfer books will be closed from 3 o'clock P.M., Dec. 20th, 1893, to 10 o'clock A.M., Jan. 3d, 1894.

967-3 FERDINAND McKEIGE, Secretary.

SITUATION WANTED

As Superintendent of a Gas Works

by a young man of 20 years' experience in all details of the business—manufacturing, mechanical and clerical. Has made the stove business a specialty for the last 8 years. Best of references.

965-4 Address "H. E.," care this Journal.

WANTED,

A First-Class Draughtsman.

Must be thoroughly conversant with coal gas machinery. State previous employers and experience. None but first-class need apply.

966-tf Address, "X," care this Journal.

Proposals for Coal Tar.

The Lebanon (Pa.) Gas Company will receive bids for their

Tar Product of 1894,

making gas under old process from best Westmoreland gas coal. 250 barrels will be about the amount of the product. Bids will be opened Jan. 1, 1894, at 2 P.M.

966-3 JOHN W. MISH, Treas.

To Gasholder Builders.

ALTOONA GAS COMPANY, ALTOONA, PA., Dec. 5, 1893.

Designs and bids will be received up to and including December 31st, 1893, for the erection of a

Three-Lift Gasholder, of One Million Feet Capacity, in a Steel Tank.

The several sections to be 30 feet deep each, and of the following diameters: Outer section, 123 feet; second section, 121 feet; inner section, 119 feet.

The designs and bids to be made for the above complete, and separate bids for the outer and second sections, with the columns so arranged that the third section can be added at any future time.

The Company reserves the right to reject any or all bids. Designs and bids to be addressed to Mr. John Lloyd, Prest., First National Bank, Altoona, Pa.

W. S. HUMES, Sec. JOHN LLOYD, Prest.

966 3

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NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to

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Valuable Gas Interest For Sale,

The undersigned will sell, to the extent of $20,000 to $50,000, in sums to suit purchaser, an interest in a growing gas business now netting 8 per cent.; increase this year will give net earnings of over 12 per cent. Money wanted for extensions to cover valuable territory. A magnificent opening for a party desiring a permanent occupation and investment in one of the most pleasant residence locations in California. Banks and business firms as references. Address for particulars and statement,

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Gas Governors, Governor Gas Burners, Gas Cocks and Fittings.

In addition to a full assortment of Volumetric Governors, etc., I am now making **MERCURY PRESSURE GOVERNORS** of all the usual sizes, adapted to use upon *Gas Stoves, Furnaces, and Meters.* The same careful attention to details of design and workmanship which has established the reputation of **WILDER'S VOLUMETRIC GOVERNORS** will be given to the new line. They have been thoroughly tested in many places during the past year, and have given entire satisfaction. The price is very low, and but for a complete system of machinery adapted to this work, it would be impossible to sell them at the price. I hope for large orders, as they become known, in consequence of the low price and good quality.

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HYDRATED OXIDE OF IRON

For Gas Purification.

Analysis, Samples and Particulars on Application.

Pamphlet Free.

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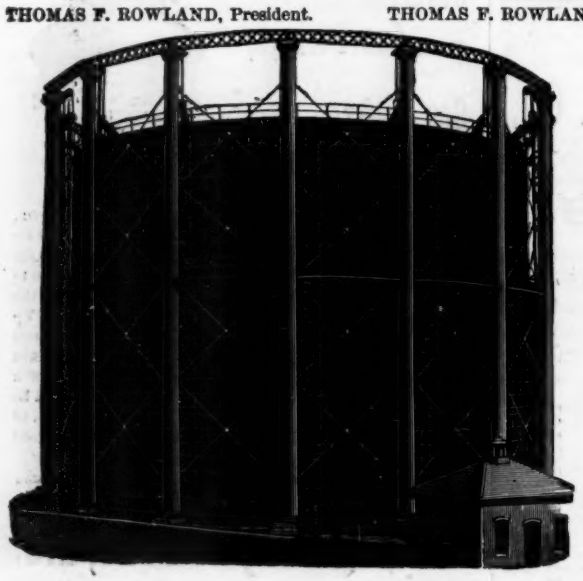

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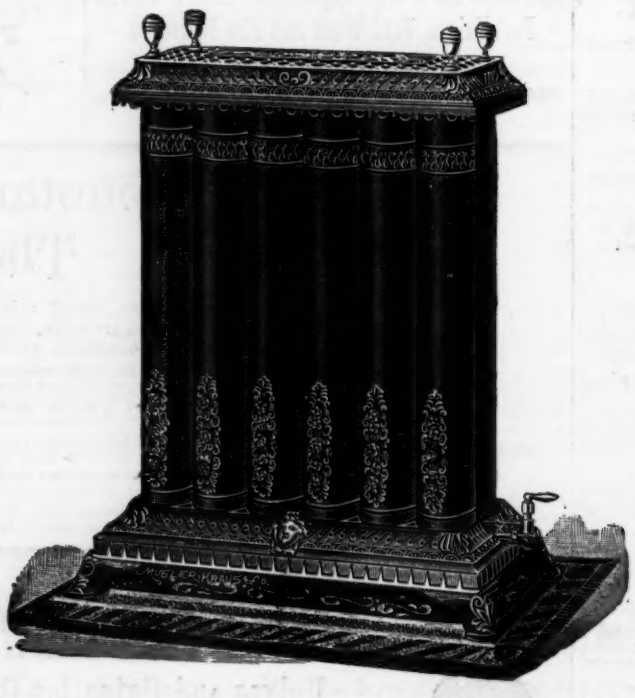

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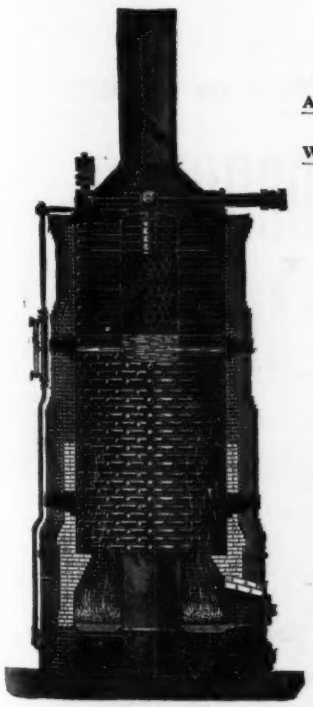

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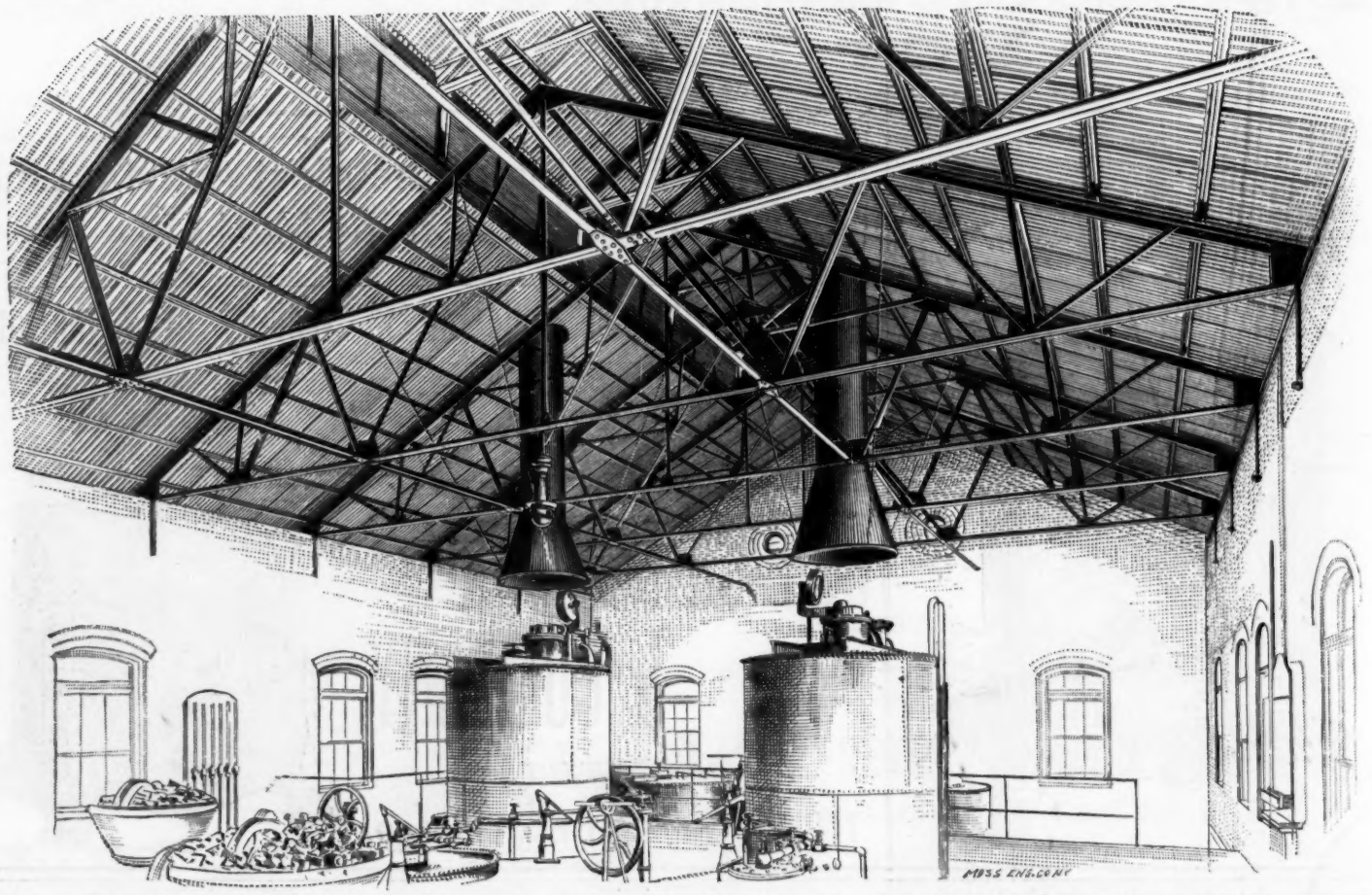

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Providence Gas Light Company, at Providence, R. I. The building is 40 ft. in width by 100 ft. in length, the side walls being of brick and the roof being entirely of iron—that is, iron trusses and iron purlins covered with corrugated iron. The building is ventilated by our Improved Ventilator, extending the full length of the roof, with side shutters opened and closed by cords from the floor. No woodwork is used in any way about the construction of the building.

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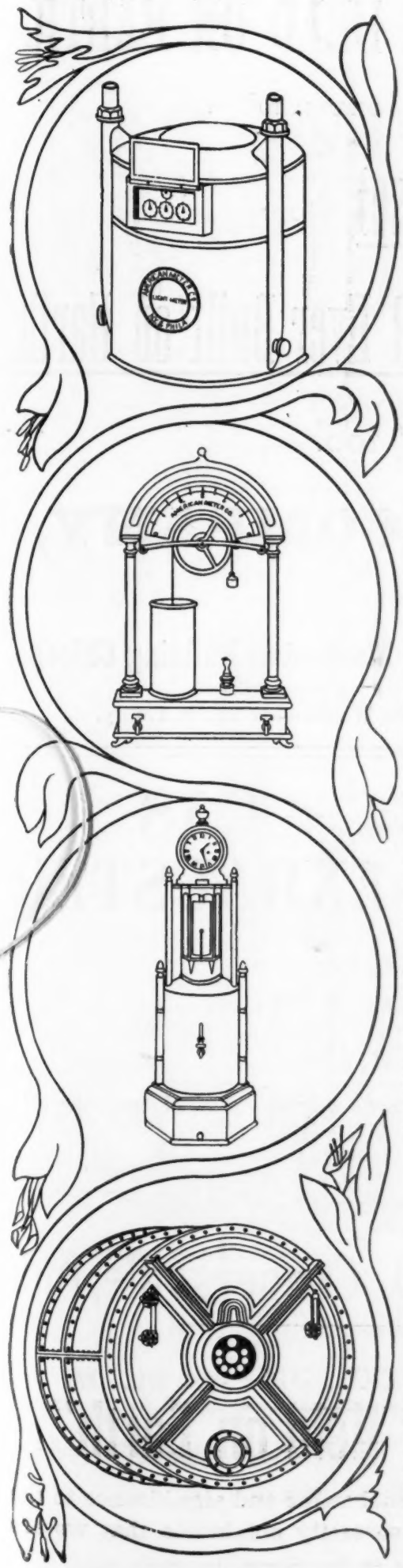

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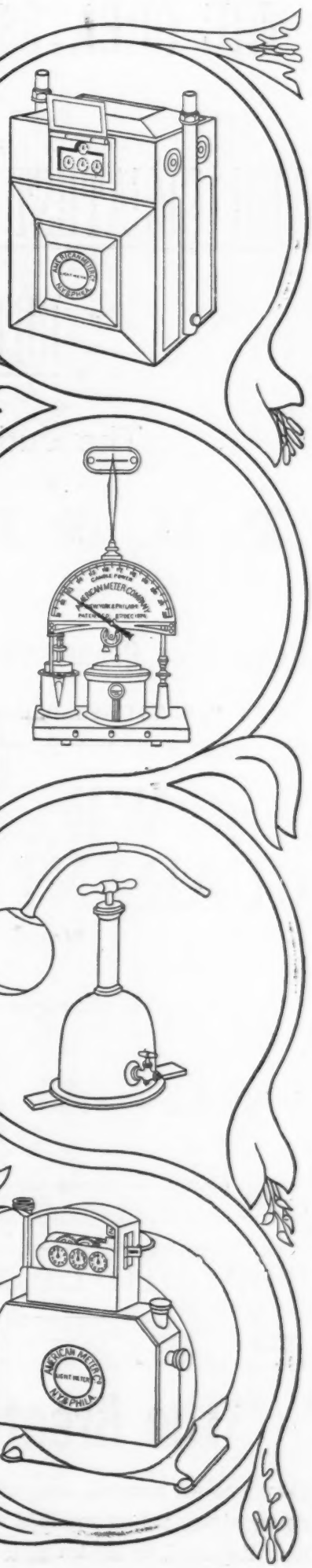
PUBLIC LIGHTING TABLE.

DECEMBER, 1893.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P. M.	A. M.
Fri.	1	5.00 PM	2.30 AM	4.20	6.10
Sat.	2	5.00	3.30	4.20	6.10
Sun.	3	5.00	4.30	4.20	6.15
Mon.	4	5.00	5.40	4.20	6.15
Tue.	5	5.00	6.10	4.20	6.15
Wed.	6	5.00	6.10	4.20	6.15
Thu.	7	5.00	6.10	4.20	6.15
Fri.	8	5.00 NM	6.10	4.20	6.15
Sat.	9	5.00	6.10	4.20	6.15
Sun.	10	5.00	6.10	4.20	6.20
Mon.	11	5.00	6.10	4.20	6.20
Tue.	12	5.00	6.10	4.20	6.20
Wed.	13	8.30	6.10	4.20	6.20
Thu.	14	9.30	6.10	4.20	6.20
Fri.	15	10.30	6.20	4.20	6.20
Sat.	16	11.30 FQ	6.20	4.20	6.20
Sun.	17	12.50 AM	6.20	4.20	6.20
Mon.	18	2.00	6.20	4.20	6.20
Tue.	19	3 20	6.20	4.20	6.20
Wed.	20	4.20	6.20	4.20	6.20
Thu.	21	No L	No L.	4.20	6.20
Fri.	22	No L FM	No L.	4.20	6.20
Sat.	23	No L	No L.	4.20	6.20
Sun.	24	5.10	7.20 PM	4.20	6.25
Mon.	25	5.10	8.40	4.20	6.25
Tue.	26	5.10	10.00	4.20	6.25
Wed.	27	5.10	11.10	4.20	6.25
Thu.	28	5.10	12.20 AM	4.20	6.25
Fri.	29	5.10 LQ	1.20	4.20	6.25
Sat.	30	5.10	2.30	4.20	6.25
Sun.	31	5.10	3.30	4.20	6.25

TOTAL HOURS LIGHTING DURING 1893.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January...	217.30	January...	423.20
February..	200.30	February..	355.25
March	177.50	March	355.35
April.....	160.30	April.....	298.50
May.....	149.00	May.....	264.50
June.....	140.30	June.....	234.25
July.....	143.40	July.....	243.45
August....	154.50	August....	280.25
September.	171.50	September.	321.15
October....	202.20	October....	374.30
November.	221.30	November.	401.40
December.	248.50	December.	433.45
Total..	2188.50	Total..	3987.45



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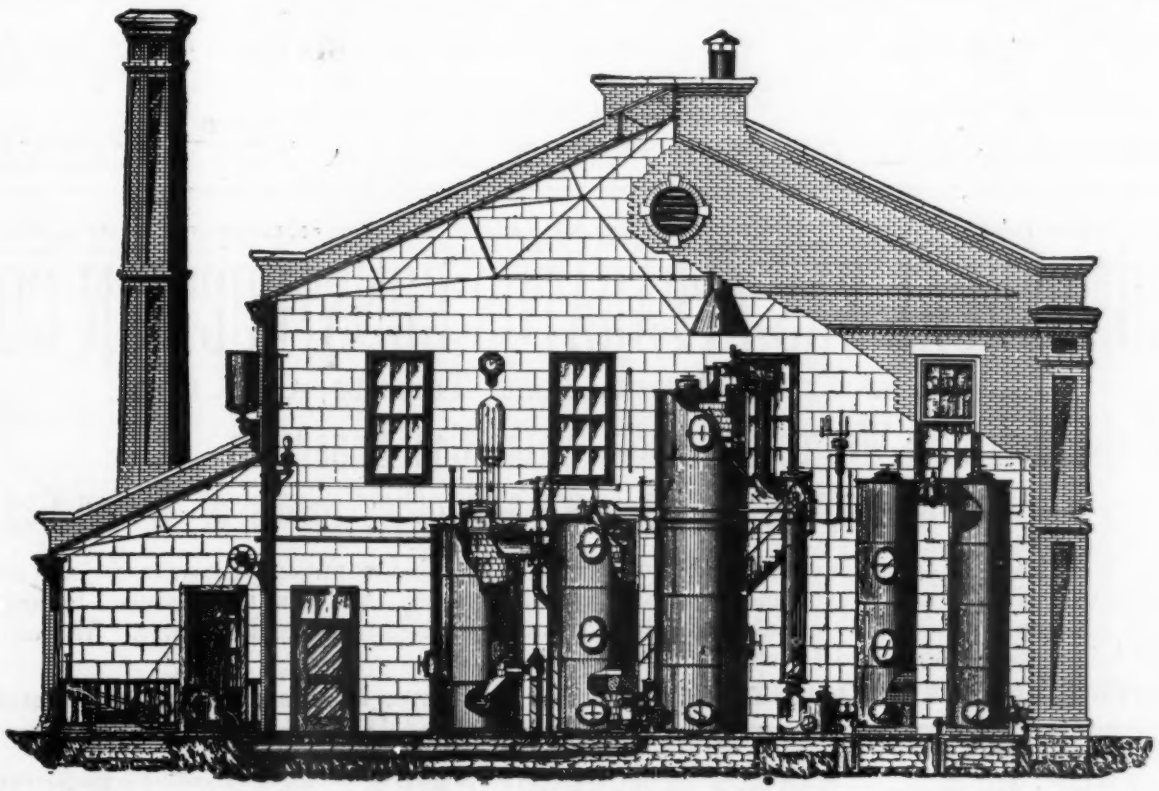

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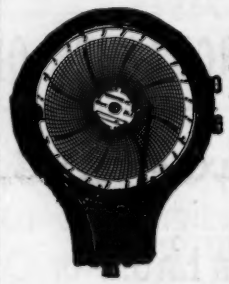

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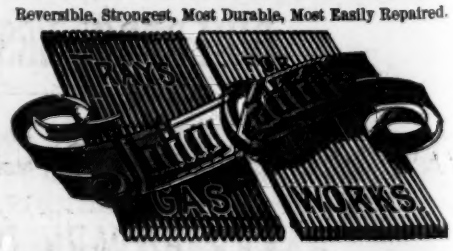

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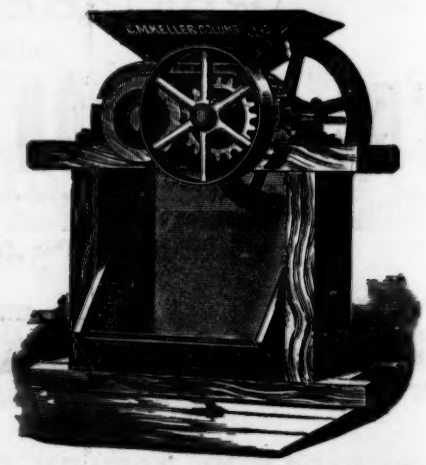

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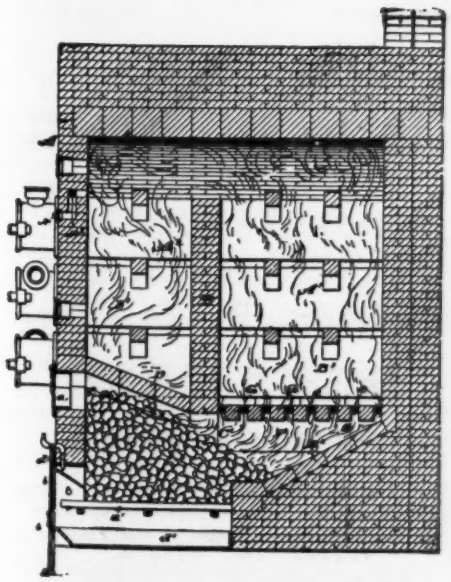

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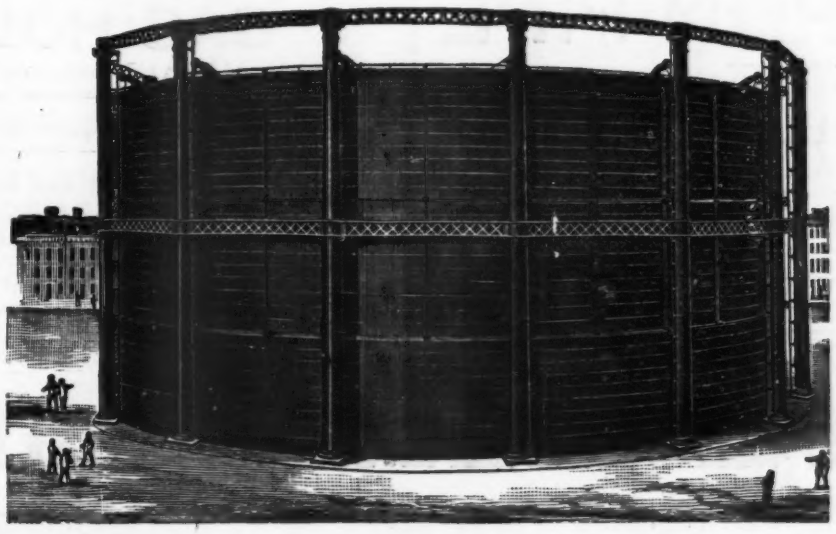

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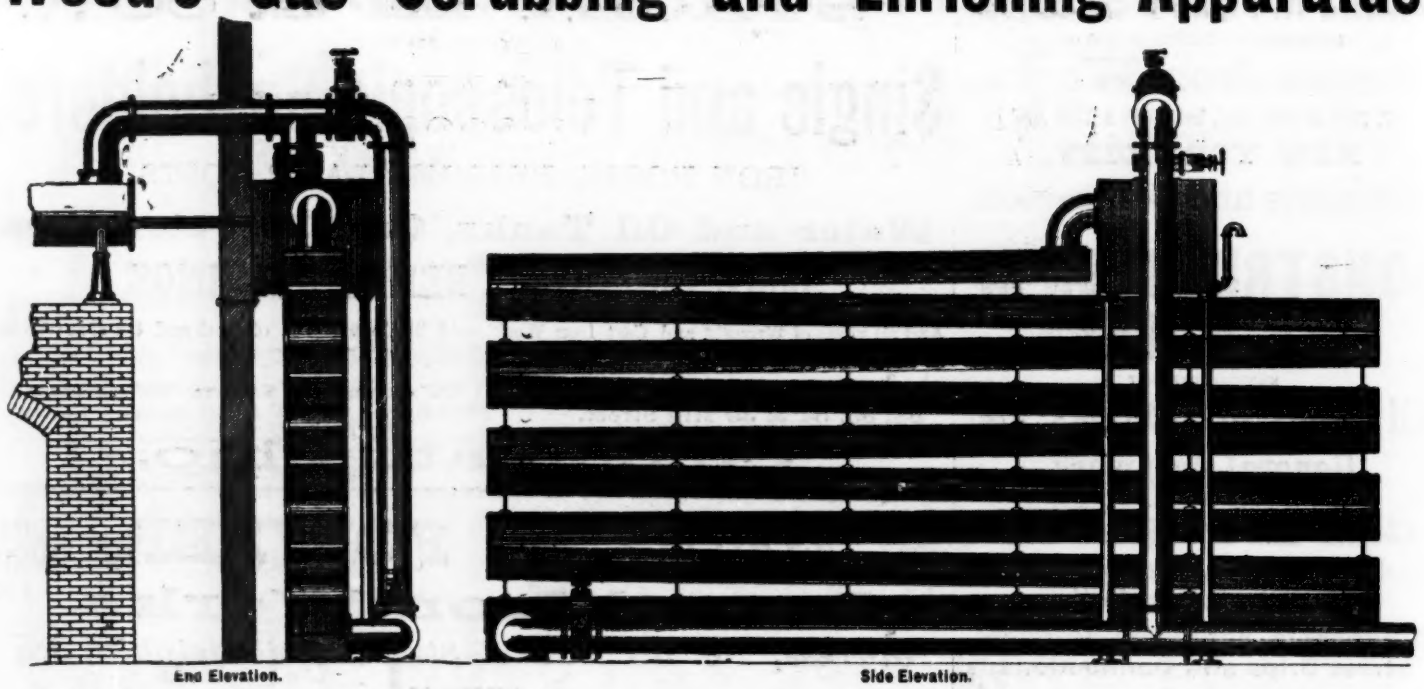

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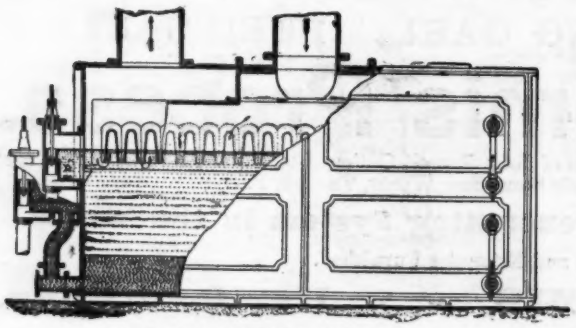

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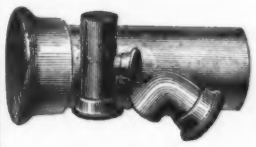

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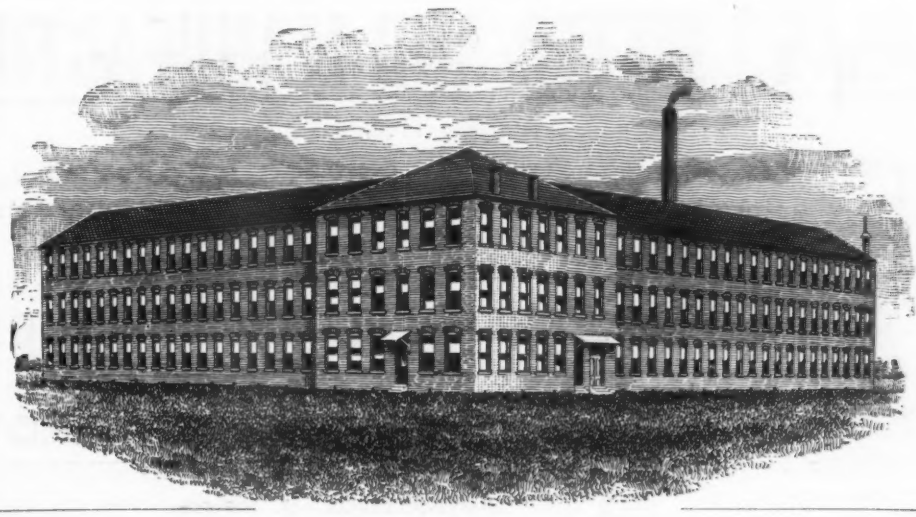

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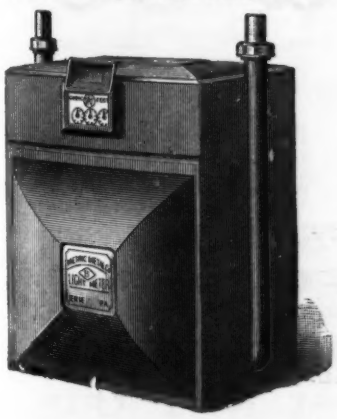

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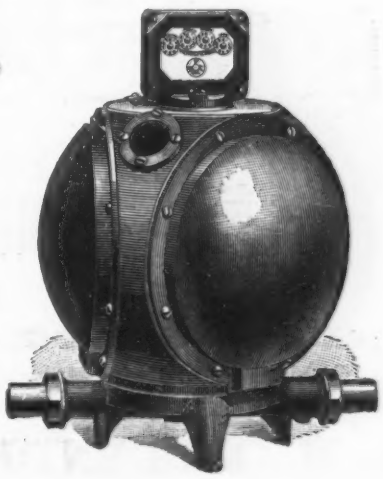

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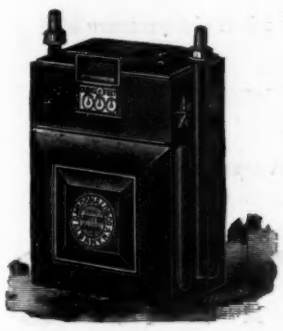

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Stove.	*Oven.*	*Broiler.*	*Top.*
31 inches high.	9¼ inches high.	10 inches high.	21 inches high.
17 inches wide.	15 inches wide.	15 inches wide.	16 inches wide.
	12¼ inches deep.	12¼ inches deep.	
	Length over extension shelves, 39 inches.		

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The consumption of this Stove is 35 cubic feet per hour, at 1½ inch pressure with all burners.

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